

The Montréal Process: Year 2000 Progress Report

April 2000



The Montréal Process: Progress and Innovation in Implementing Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests

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in Implementing Criteria and Indicators for the Conservation and
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Table of Contents

1	Introduction
1	Background
4	Vignette on Argentina
10	Vignette on Australia
23	Vignette on Canada
29	Vignette on Chile
36	Vignette on China
46	Vignette on Japan
58	Vignette on Korea
64	Vignette on Mexico
65	Vignette on New Zealand
73	Vignette on Russia
77	Vignette on United States
81	Vignette on Uruguay
88	Discussion
90	Appendix A
	Montréal Process Criteria and Indicators of the Conservation and Sustainable Management of Temperate and Boreal Forests

Introduction

This Year 2000 Report on the Montréal Process has been prepared for presentation at the Eighth Session of the United Nations Commission on Sustainable Development (UNCSD), to be held in April 2000 in New York, USA, and at the XXI World Congress of the International Union of Forestry Research Organizations (IUFRO), to be held in August 2000 in Kuala Lumpur, Malaysia.

1

The report, which incorporates input from individual countries, highlights accomplishments in implementing the criteria and indicators of the Montréal Process, including capacity-building, data collection, forest management, institutional and regulatory policy development, and technical co-operation. Countries have prepared "vignettes" which describe experiences and provide examples of progress and innovation in implementing criteria and indicators and related policy initiatives to promote sustainable forest management (SFM).

After a brief introductory chapter, a short history of the Montréal Process is included. This is followed by presentation of the vignettes on participating countries. The report continues with a discussion concerning the strengths and added values provided by working within the framework of the Montréal Process, and concludes with a statement concerning future actions to be taken by the Montréal Process Working Group. The list of Montréal Process criteria and indicators is attached to the report (Appendix A).

Background

In 1993 Canada convened an International Seminar of Experts on Sustainable Development of Boreal and Temperate Forests. This meeting, held in Montréal, was sponsored by the Conference on Security and Co-operation in Europe (CSCE), now the Organisation for Security and Co-operation in Europe (OSCE). The seminar focused specifically on criteria and indicators and provided a conceptual basis for subsequent regional and international work.

The Montréal meeting represented a response to the United Nations Conference on Environment and Development (UNCED) which was held in Rio de Janeiro in June 1992. The conference had focused world attention on the importance of sustainable forest management as a key component of sustainable development, defined as meeting the needs of today without hurting the ability of future generations to meet their needs.

Following the CSCE seminar, the Ministerial Conference on the Protection of Forests in Europe elected to work as a region under a pre-existing initiative. Canada then took the lead in launching an initiative among non-European countries having boreal and temperate forests. The objective of this initiative was to develop and encourage implementation of internationally agreed-on national-level criteria and indicators for sustainable forest management. In Geneva in 1994 the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests was formed; this is now known as the Montréal Process.

Twelve countries are involved in the Montréal Process Working Group — Argentina, Australia, Canada, Chile, China, Japan, Republic of Korea, Mexico, New Zealand, Russian Federation, United States of America and Uruguay. These countries together represent about 60 per cent of world's forests, about 90 per cent of the world's temperate and boreal forests, 45 per cent of world trade in wood and wood products, and 35 per cent of the world's population.

Between June 1994 and February 1995, the Montréal Process countries met five times to pursue the development of a comprehensive set of criteria and indicators. At the Sixth Meeting, in Santiago, Chile, in February 1995, the 10 original participating countries endorsed a statement of political commitment known as the *Santiago Declaration*, together with a comprehensive set of criteria and indicators for use by policy makers, practitioners, and the general public (see Appendix A). Subsequently the declaration was endorsed by Argentina and Uruguay who have become members of the Montréal Process. Since its inception, the Liaison Office for the Process has been hosted by the Canadian Forest Service. The office, located in Ottawa, provides various services including document preparation and distribution, process co-ordination and various clearing-house functions.

Over the past five years a number of publications have been issued by the Montréal Process. The first report, issued in May 1996 and entitled *Status of Data and Ability to Report on the Montréal Process Criteria and Indicators*, summarised the responses to a questionnaire, which had been designed to assess the availability of data and to identify the ability of countries to report on the criteria and indicators. Subsequently, in February 1997, a progress report on implementation of the Process was released. This report included brief vignettes for 10 of the countries; these vignettes provide information on the unique experiences of each country, the great variation from country to country and the special challenges or issues faced by individual countries.

A *First Approximation Report of the Montréal Process* was issued in August 1997. This report reviewed the history of the Montréal Process and its criteria and indicators and provided a summary of more recent Montréal Process activities, including early implementation. Advice concerning the preparation of the report was provided by the Technical Advisory Committee (TAC). The report was primarily devoted to member-country responses to a call for updated information on the status of data assembly and on key issues associated with implementation of the Process. The survey revealed that there was a reporting rate of 87 per cent for all indicators, that data were being collected for 68 per cent of the indicators, and that specific detail was being provided for 39 per cent of the indicators. It was revealed, however, that there were gaps in the ability to report for 50 per cent of the indicators. These country reports are the key to future reports in that they provide baseline information and highlight the gaps in the available national data for each indicator.

A technical report prepared by the TAC is currently under review by the Montréal Process Working Group. A brief explanation or rationale, definitions of key terms and suggested measurement approaches are included for each indicator. The measurement approaches suggested do not necessarily represent the latest available techniques, but focus on useful and cost-effective techniques. Possible techniques are included for all indicators, even when measurement approaches may be difficult to implement fully in the short term.

Criteria and Indicators

Criteria and indicators are tools for characterising the state of a nation's forests and for providing information on how forest lands and uses are changing. This information is vital in formulating policies that promote sustainable forest management and can be used to assess national trends. Information on trends is an essential step in measuring progress toward the goal of sustainable forest management.

Comparisons of periodic national reports on the various indicators will assist the public and decision-makers to identify the current status and trends in most aspects of forests. Over time, they will document the changes and outcomes that result from forest management.

Specifically, the seven criteria identified in the Montréal Process are the essential components of the sustainable management of forests. They include vital functions and attributes (biodiversity, productivity, forest health, carbon sequestration, and soil and water protection), socio-economic benefits (timber, recreation and cultural values), and the laws and regulations that constitute the forest policy framework. The criteria and indicators provide a framework for answering the fundamental question, "What is important about forests?" The Montréal Process indicators provide ways to assess or describe a criterion. Many indicators are quantitative, whereas others are qualitative or descriptive. All indicators provide information about the present conditions of forests and their use and, over time, will establish the direction of change in these variables. It is also recognised that whereas many of the indicators can be readily measured, others will involve the gathering of new and additional data, a new program of systematic sampling, or even basic research.

Together, the seven criteria and the 67 indicators of the Montréal Process reflect an ecosystem-based approach to sustainable forest management and the need to serve human communities. The criteria and indicators are not static; they will be reviewed and refined continuously to reflect new research, advances in technology, increased capability to measure indicators and an improved understanding of what constitutes appropriate assessment indicators.

Vignette on Argentina

Criterion 1: Conservation of Biological Diversity

A major inventory of forest plantations began in November 1997 and will be completed in May 2000. Partial information, including range and extension of forest species, total wood volume and species age, has been elaborated on provincial maps at a scale of 1:100 000. Total areas of forest by province are given in Table 1, with a map of provinces in Figure 1.

Also, a geographic information system, based on the indicators noted in the previous sentence and on the interpretation of satellite images, has been developed. The inventory is being carried out by the Forest Development Project, under the direction of the Secretariat of Agriculture, Livestock, Fisheries and Food (IBRD).

Figure 1. Provinces of Argentina



Table 1. Planted forests by province

Provinces	Planted forest area (ha)
Buenos Aires	144 537
Catamarca	15
Córdoba	41 470
Corrientes	187 967
Chaco	1 620
Chubut	5 063
Entre Ríos	86 962
Formosa	389
Jujuy	18 986
La Pampa	2 701
La Rioja	
Mendoza	14 500
Misiones	197 000
Neuquén	41 094
Río Negro	20 712
Salta	3 479
San Juan	4 524
San Luis	483
Santa Cruz	2 139
Santa Fe	30 414
Santiago del Estero	3 833
Tierra del Fuego	0
Tucumán	4 999
Total	812 887

Table 2. Native forest by region

Natural regions (forested)	Natural forest area (ha)	Percentage
Parque Chaqueño (Chaco parkland)	25 750 000	68.9
Selva tucumano-boliviana (Tucumán-Bolivia forest)	2 490 000	6.7
Selva misionera (Misiones forest)	2 060 000	5.5
Bosques subantárticos (Subantarctic woodland)	1 970 000	5.3
Monte occidental (Western mountains)	1 880 000	5.0
Bosque pampeano (La Pampa woodland)	1 790 000	4.8
Parque mesopotámico (Inter-river parkland)	1 440 000	3.8
Total	37 380 000	100

The Environment Secretariat is preparing the native forest inventory.

Forest types in Argentina, which totalled 60 300 000 hectares in 1970, and now total 37 380 000, have been classified into seven categories: Selva Misionera, Selva Tucumano-boliviana, Parque Chaqueño, Parque Mesopotámico, Bosque Pampeano, Monte Occidental, y Bosques Subantárticos. Forested areas by region are listed in Table 2 with a map of regions shown in Figure 2.

There are many categories of protected areas in Argentina. The largest are natural environment conservation areas, which cover 13 695 183 hectares. Also, 224 reserved areas have been established to protect landscapes and other land use under the provincial and national natural parks laws.

National Forest Reserves have been designated in 34 sites covering 2 590 301 hectares to conserve natural ecosystems.

Criterion 2: Maintenance of the Productive Capacity of Forest Ecosystems

The greatest progress has been made on plantations. Forest plantations, in 1992, totalled 20 000 hectares per year, and currently total 120 000 hectares per year. Forest policy has emphasised the expansion of commercial forests, to decrease the deterioration of native forest biomass. According to estimates for the next 10 years, commercial forest lands will occupy about 2 000 000 hectares.

Figure 2. Natural regions of Argentina



Criterion 3: Maintenance of Forest Ecosystem Health and Vitality

The National Agrifood Health and Quality Service, which participates in the Forest Agricultural Health Program is undertaking research on the pine-tree boring wasp (*Sirex noctilio*). At the same time, the program has signed an inter-institutional agreement with the Paraná Delta Producers' Council.

7

Additionally, in November 1991, a permanent Working Group on Forest Agricultural Health was created under the South Cone Plant Health Committee established by Argentina, Brazil, Chile, Uruguay and Paraguay. The priority objectives of this group are to analyse forest health questions in the region, to co-ordinate actions, to exchange experiences advising the directive committee.

Criterion 4: Conservation and Maintenance of Soil and Water Resources

The Secretariat of Agriculture, Livestock, Fisheries and Food, through the Forest Development Project (SAGPyA/IBRD), has completed a study on desertification in Patagonia. One of the study's conclusions was the importance of forestation in erosion control. The study was carried out by DHV consultants BV (Holland) — SCC Swedforest International AB (Sweden), with experts from the National Agricultural Technology Institute and the Faculty of Agronomy of Buenos Aires University.

Criterion 5: Maintenance of Forest Contribution to Global Carbon Cycles

The native forest area in Argentina is estimated at about 37 000 000 hectares, and with an annual growth rate of 3 cubic metres per hectare, is increasing in volume at a rate of 105 000 000 cubic metres per year. Likewise, the forest plantations, which cover 1 000 000 hectares and have an average annual growth rate of 15 cubic metres per hectare, are increasing in volume at about 15 000 000 cubic metres per year. Accordingly, with silvicultural practices, Argentina has capacity to realise carbon absorption (Tables 3 and 4).

Table 3. Carbon sequestered by plantation forests (per hectare)

Species	Commercial annual growth rate (m ³ /ha)	Adjustment for roots and branches	Carbon pool (t/m ²)	Total carbon (t/ha)
<i>Araucaria</i>	18	1.4	0.26	6.6
<i>Pinus elliotii</i>	25	1.4	0.26	9.1
<i>P. taeda</i>	28	1.4	0.26	10.2
<i>P. caribaea</i>	33	1.4	0.26	12.0
<i>Eucalyptus</i>	35	1.4	0.6	12.7
<i>Populus</i>	35-40	1.4	0.26	12.7

Table 4. Net carbon in forests at the end of first rotation

Prior use	C released in conversion (t) (2)	C captured in forest (t/year) (3)		Net C/ha of new plantation (3)-(2)=(4)	
		Max	Min	Max	Min
Agricultural crops	0	12.7	6.6	381	198
Pastures	0	12.7	6.6	381	198
Abandoned agricultural lands with regrowth	50	12.7	6.6	331	148
Delta wetlands (9 years)	0	12.7	6.6	114	59

Criterion 6: Maintenance and Enhancement of Long-Term Multiple Socio-economic Benefits to Meet the Needs of Societies

The Secretariat of Agriculture, Livestock, Fisheries and Food, under the Ministry of Economy and Public Services and Works, is responsible for execution of the Forest Development Project.

The principal benefits foreseen by the project will include the following:

- A more efficient political-regulatory framework to develop ecological potential, in sites highly suitable for forestry but marginal for other activities
- Direct emphasis on increased productivity
- Prioritisation of effort for regions showing economic and ecological advantages
- Quality improvements in wood to be harvested and diversification of manufacturing alternatives
- Recovery of fragile or deteriorated zones, helping to diminish the pressure on natural forests
- Strengthening of peripheral research, information and extension services
- Greater participation of the private sector, in production as well as in services
- Creation and implementation of options to improve family incomes of small producers
- Enhanced technical and administrative forest capability in the public sector
- Training of technical and managerial staff in private and public areas

Criterion 7: Legal, Institutional and Economic Framework for Forest Conservation and Sustainable Management

Basically, the legal framework is composed of the legislation listed in Table 5:

Table 5. Legal framework for forest conservation and sustainable management

Sector	Conservation law
Protected areas	Law 22351 and decree regulation 637
Protected areas	Decree 1979/78
Flora	Law 12273
Flora	Law 23973
Fauna	Law 22421/81 and regulation 691/81
Land	Law 22428 and regulation 681/81
Water	Law 2797/91
Water	Law 20481 and regulation 1886/83
Water	Law 23615
Water	Decree 2125/78
Water	Decree 776/92
Atmosphere	Law 20282
Atmosphere	Law 24040
Pesticides and fertilisers	Laws 3489, 18073, 18796, 18323, 20026, 20316, 20418, 20466 and 22289

Furthermore, Argentina is part of several international conventions on conservation and protection of the natural resources (Table 6).

Table 6. Participation in international conventions

Subject	Agreement	Year of ratification
Biodiversity	Protection of wildlife	1946
Biodiversity	Ramsar	1971
Biodiversity	CITES	1973. Law 22344/ 80
Biodiversity	Conservation of migratory fauna (Bonn)	1979. Law 23818
Biodiversity	Biodiversity (Rio de Janeiro)	1992
Atmosphere	Protection of ozone (Vienna)	1985 Law 23724
Atmosphere	Montréal Protocol	1987
Atmosphere	Climate Change Framework	1994
Health of vegetation		Various

The policy and legislative framework for forests has considered the following objectives in the Cultivated Forest Investment Law (Nº 25.080/99) and the Decree (Nº 133/99):

- Protection of natural forests, prohibiting their use except where management plans to promote active management have been approved
- Expansion of the forest base through forest plantations, using appropriate species on land with medium to low agricultural productivity, with an approved sustainable management plan.

Vignette on Australia

Summary

This report highlights developments since 1997, when Australia's First Approximation Report (FAR) was produced. Australia finalised *A framework of regional (sub-national) level criteria and indicators of sustainable forest management in Australia* in 1998, after a two-year consultative process between government agencies at Commonwealth (Federal), State and Territory levels, and stakeholders. The framework was endorsed by forestry and environment Ministers at all levels and was released publicly in August 1998. The framework is based on the internationally accepted national-level criteria and indicators of the Montréal Process. It provides a co-ordinated approach to monitoring trends in forest conditions and to the sustainability of Australia's forest management practices at a sub-national level. This will enable data to be aggregated for use at the national level. A phased approach to implementation of indicators has been agreed on, giving States and Territories flexibility regarding implementation.

To support this work, Australia is undertaking a number of research and development projects that aim to deliver practical, cost-effective and sensitive indicators. As outlined in the FAR, several key challenges exist for Australia, including collection of data from non-commercial forests on public land and from the large majority of privately managed forests. Given that these tenures constitute about 90 per cent of Australia's forest estate of 157 million hectares, this amounts to a significant issue.

Development of a Framework of Criteria and Indicators for Use at Sub-national Level

In July 1996, Australia's Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA) requested that a framework of regional-level criteria and indicators be developed. The MCFFA's Standing Committee on Forestry (SCF) and the Australian and New Zealand Environment and Conservation Council's (ANZECC) Standing Committee on Conservation (SCC) agreed to establish the Montréal Process Implementation Group for Australia (MIG), a Commonwealth-State body, to develop the framework of regional criteria and indicators. The MIG process has included stakeholder meetings, expert workshops, seminars and a period for public comment. Stakeholders and experts provided input on the adequacy of the indicators to capture key attributes of sustainable forest management (SFM) at a regional (sub-national) scale and for Australian conditions. Advice was also provided on research needs.

The MIG process confirmed that the seven Montréal Process criteria are relevant to all land tenures and all forest types in Australia. However, consistent with Australia's National Forest Policy Statement, the application and importance of the criteria and their respective indicators will vary among tenures and broad forest types.

Of the 67 Montréal Process (national) indicators, 30 have been accepted as regional-level indicators and 10 have been classed as not relevant at a regional level. Twenty-five national-level indicators have been reworded to reflect regional issues more accurately, and two indicators have been amalgamated with related indicators. Twelve new or interim indicators have been developed for use at the regional level. In summary, the regional framework also has 67 indicators.

There has been agreement in Australia that it is not possible, practical or cost-effective to fully implement and monitor all indicators in the framework at this time. Therefore, the framework identifies three sub-sets of indicators:

- Category A, which can be measured immediately for most forests
- Category B, which require further work on methods or resourcing before indicators can be implemented
- Category C, where significant research and development is required to develop practical, sensitive and cost-effective implementation (see Table 7).

Table 7. Phased implementation of indicators

Category A Largely implementable now	Category B Require some development	Category C Require longer-term R&D
1.1.a Extent of area by forest type and tenure. (Amended to include 1.1.c)	1.1.e Fragmentation of forest types.	1.2.c Population levels of representative species from diverse habitats monitored across their range.
1.1.b Area of forest type by growth stage distribution by tenure. (amended to include 1.1.d)	5.1.a Total forest ecosystem biomass and carbon pool, and if appropriate, subtotals by forest type, age class, and successional stages.	1.3.a Amount of genetic variation within and between populations of representative forest dwelling species.
1.2.a A list of forest dwelling species.	6.1.a Value and volume of wood and wood products production, including value added through downstream processing.	3.1.a Area and percentage of forest affected by processes or agents that may change ecosystem health and vitality.
1.2.b The status (threatened, rare, vulnerable, endangered, or extinct) of forest dwelling species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment	6.3.a Value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation and tourism.	3.1.c Area and percentage of forest land with diminished or improved biological, physical and chemical components indicative of changes in fundamental ecological processes.
2.1.a Area of forest land and net area of forest land available for timber production.		
2.1.d Annual removal of wood products compared to the sustainable volume.		

Table 7. cont'd

Category A Largely implementable now	Category B Require some development	Category C Require longer-term R&D
<p>2.1.f Area and percentage of plantation established that meets effective stocking one year after planting.</p> <p>2.1.g Area and percentage of harvested area of native forest effectively regenerated.</p> <p>3.1.a Area and percentage of forest affected by processes or agents that may change ecosystem health and vitality. (A narrative as interim)</p> <p>4.1.a (Interim) Area and percentage of forest land systematically assessed for soil erosion hazard, and for which site-varying scientifically-based measures to protect soil and water values are implemented.</p> <p>6.2.c Number of visits per annum.</p> <p>6.5.a Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment. (Direct)</p> <p>7.1 (Narrative) <i>Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests.</i></p> <p>7.2 (Narrative) <i>Extent to which the institutional framework supports the conservation and sustainable management of forests.</i></p> <p>7.4 (Narrative) <i>Capacity to measure and monitor changes in the conservation and sustainable management of forests.</i></p> <p>7.5 (Narrative) <i>Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services.</i></p>	<p>6.4.a(i) (priority areas) Area and percentage of forest lands in defined tenures, management regimes and zonings which are formally managed in a manner that protects Indigenous peoples' cultural, social, religious and spiritual values, including non-consumptive appreciation of country.</p> <p>6.4.a(ii) Proportion of places of non-Indigenous cultural values in forests formally managed to protect these values.</p> <p>6.5.a Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment. (Indirect)</p> <p>6.6.a Extent to which the management framework maintains and enhances Indigenous values including customary, traditional and native title use by Indigenous peoples and for Indigenous participation in forest management.</p>	<p>4.1.c Percentage of stream kilometres in forested catchments in which stream flow and timing have significantly deviated from the historic range of variation.</p> <p>4.1.d Area and percentage of forest land with significantly diminished soil organic matter or changes in other soil chemical properties or both.</p> <p>4.1.d (Interim) The total quantity of organic carbon in the forest floor (components < 25 mm in diameter) and the surface 30 cm of soil.</p> <p>4.1.e Area and percentage of forest land with significant compaction or change in soil physical properties resulting from human activities.</p> <p>4.1.f Percentage of water bodies in forest areas (e.g., stream kilometres, lake hectares) with significant variance of biological diversity from the historic range of variability.</p> <p>6.1.b Value and quantities of production of non-wood forest products.</p> <p>6.2.b Number, range and use of recreation and tourism activities available in a given region.</p> <p>6.5.c(i) Viability and adaptability to changing social and economic conditions of forest dependent communities.</p> <p>6.5.c(ii) Viability and adaptability of forest dependent Indigenous communities.</p>
Total: 12 Indicators and 4 sub-criteria	Total: 8 indicators	Total: 13 indicators

Research and development work is being funded for these indicators. As this research is completed, the indicators will be reviewed to establish the feasibility of their inclusion in Category A. The three categories cover all seven Montréal Process criteria, and provide a strategy for phased implementation.

The remaining 20 indicators are not seen as having a high priority for regional implementation, or for research and development, over the short to medium term. However, they may be important in particular regions and could be adopted where needed.

Although Australia is committed to monitoring and reporting against the regional framework of criteria and indicators, there is no expectation of uniform implementation of indicators across the nation. It is also worth noting that the framework is not legally binding, nor is it a compliance document or an operations manual.

The ability of agencies, industry, forest owners and growers, and the broader community to contribute to monitoring will vary.

Links with Other Domestic and International Activities

There are important linkages between the implementation of the framework and work being undertaken on other key initiatives, including Australia's Regional Forest Agreement process, the National Forest Inventory, State of the Forest and State of the Environment reporting, greenhouse activities, and international reporting. Not only does the framework provide a common approach to monitoring, with the specific purpose of progressively improving forest management on all land tenures, it endeavours to avoid duplication in forest-related data collection. The framework will allow aggregation of data from the regional level to a State and national level in a transparent and credible way in both Regional Forest Agreements (RFAs) and non-RFA regions.

Regional Forest Agreements

A key element of the approach adopted in Australia's National Forest Policy Statement involves RFAs between the Commonwealth and State governments, which are being developed following comprehensive studies of forest values and consultation with stakeholders. The agreements will seek to conserve the full suite of environmental and heritage values that forests can provide for current and future generations by ensuring that the forest conservation reserve system is comprehensive, adequate and representative, and through the complementary management of forests outside reserves. Secure access to wood resources will be provided through these agreements, enabling continued development of internationally competitive and ecologically sustainable industries. The RFAs cover over 25 million hectares (approximately 16 per cent of the forest estate). To date, all signed RFAs have included references to identification of sustainability indicators based on the regional framework. Considerable progress has been made in New South Wales and Tasmania on identification of indicators for monitoring. Although preliminary resource assessment has been undertaken on private native forests in most RFA areas, only Tasmania has included both the private and the public forest in their final resource analysis.

National Forest Inventory

The National Forest Inventory (NFI) was established in 1988 by the Commonwealth, State and Territory governments to co-ordinate the gathering and use of forest information nationally. Ministerial Councils have tasked the NFI with the production of five-yearly State of the Forest reports based on the regional framework.

State of the Forests and State of the Environment Reporting

Ministerial Councils have also agreed that the preparation of national State of the Forest reports be aligned with all other national and international reporting requirements. This means that the State of the Environment and Montréal Process reporting will be based on data collected for the regional framework.

Greenhouse

As part of Australia's National Greenhouse Strategy, a number of activities are being undertaken that will improve knowledge of the contribution forests make to carbon fluxes and sinks. A Co-operative Research Center for Greenhouse Accounting was established in 1999 and will undertake research aimed at increasing certainty in measurement and predictions of stocks and fluxes of carbon in Australian vegetation at both continental and project scales. Information gathered will be directly related to Criterion 5 of the regional framework. A National Carbon Accounting System is being developed within the Australian Greenhouse Office that provides a comprehensive framework for reporting storage and emissions of carbon dioxide and other greenhouse gases in the Australian landscape. These two initiatives will provide a basis for State and national agencies reporting under Criterion 5.

Certification and Labelling

Australia acknowledges that the Montréal Process criteria and indicators have no automatic link to certification and labelling. Certification and labelling schemes could draw on information and methods employed in this assessment of SFM (including relevant criteria and indicators). An Australian Forestry Standard is being developed, as a basis for voluntary certification, by Australian Commonwealth, State and Territory forestry ministers. The standard will be developed through a process that actively solicits and transparently considers the views of a wide range of stakeholders. Such an approach would seek to combine environmental performance elements that address the Montréal Process criteria and systems elements drawn from ISO 14001. Australia will also be seeking to co-operate with Montréal Process countries and other interested countries to explore an internationally co-operative approach to certification and labelling.

International Reporting

As mentioned previously, data collected for the regional framework will be used for international reporting to the Montréal Process. The criteria are equivalent and the indicators are largely the same. Australia has contributed to the Global Forest Resources Assessment 2000 Programme by responding to the assessment enquiry in 1998-99 and also by participating in the development of a Global Ecological Zone Map.

International Co-operation

Australia has been active in international co-operation on criteria and indicators. Australia and China have jointly organised two workshops, the first of which was held in Fuzhou, China, in December 1997 and investigated China's national-level indicators. The second was held in Melbourne following the Conference of International Union of Forestry Research Organizations in August 1998 and aimed to accelerate progress on implementation of criteria and indicators through capacity and confidence building.

Highlights of Work being Undertaken at State and Territory Level

In New South Wales, the State Forests Service (NSW SF) commenced implementation of criteria and indicators for sustainability in 1997 prior to completion of the regional framework. The initial 17 indicators selected by NSW SF after extensive consultation fitted under the Montréal Process criteria and were reported on in the first Environmental and Social Values Report of 1997-98. From 1999 onward, the Category A indicators are being incorporated into the State Forests sustainability monitoring process. Discussions are in progress with other agencies to co-ordinate implementation of criteria and indicators on other tenures.

In Victoria, the RFAs specify that a set of sustainability indicators will be established to monitor forest changes and that these will be consistent with the Montréal Process criteria and indicators. Research and development programmes have been reconfigured to address the need to monitor against indicators. With respect to native forests, Victoria has identified a number of Montréal Process indicators considered relevant to its forests, for which information can be provided now and after further research and development. The private forests sector in Victoria is assessing options for implementation.

Queensland expects to utilise indicators in its RFA process. The Department of Natural Resources has undertaken substantial work in developing these indicators and is developing an implementation strategy for Category A indicators. A three-tier monitoring strategy is being advanced which involves long-term reference sites, permanent plots and temporary plots. Queensland has initiated and is further developing research and monitoring projects for Category B and C indicators. Queensland is considering expanding the forest monitoring plots to regions outside the RFA area, and to include privately owned forests and reserve systems.

Western Australia will focus on Category A indicators. Limited data are available for forested lands that are not managed by the Department of Conservation and Land Management, that is, land vested in or owned by other government agencies or local government and private and leasehold land. The initial focus will be on the RFA area. Future work is likely to address the temperate and tropical areas. Partnerships with other agencies and organisations will be required.

Tasmania is unique in that the whole state is an RFA area. Tasmania, together with stakeholders and the Commonwealth, intends to identify a set of indicators that will be used for monitoring the RFA by December 1999.

In those State and Territories where RFAs are not being pursued, the focus on implementation of indicators is variable. The South Australian forest management agency, ForestrySA, manages a sizeable plantation estate with only a relatively small area of multiple use forest. The state has recognised the importance of advancing implementation of indicators for the entire forest sector in South Australia.

Interestingly, it is production forest agencies that have been leading the way on implementation. A continuing effort is required to ensure that all forest management agencies are engaged in the process and that innovative mechanisms for engaging industry, private forest owners and growers, academia, research bodies and the community are developed.

It is essential that the linkages among the above activities are strengthened and duplication avoided, if not eliminated.

Research and Development

As mentioned above, to assist with the implementation of the framework of regional indicators, research is being undertaken into the development and implementation of cost-effective and practical indicators of SFM. The Forest and Wood Products Research and Development Corporation manages the funds on behalf of Agriculture, Fisheries and Forestry — Australia (AFFA). Brief details of the projects are provided in Table 8.

Tables 9 to 13 provide core data on some Category A indicators.

Table 8. Forest sustainability indicator research and development projects

Title of project (related indicator)	Progress and key contact
Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment (6.5a).	Concluded — The Final Report, including recommendations, will be available by mid-1999. Contact: John Dargavel, Australian National University Phone: 61(0)2 6249 2118 Fax: 61 (0) 2 6249 0312
Soil-based information for developing sustainable plantation forestry in Australia (4.1d, 4.1e).	This project is an extension of a current project investigating plantation sustainability indicators and is not due to commence until October 1999. Contact: Russell Haines, Queensland Forest Research Institute Phone: 61 (0) 7 3896 9703 Fax: 61 (0) 7 3896 9848
Evaluation of key soil indicators of sustainability in Australian mediterranean forests (4.1d, 4.1e).	In progress. Contact: John McGrath, Western Australia Conservation and Land Management Phone: 61 (0) 8 9334 0303 Fax: 61 (0) 8 9334 0326
Evaluation of soil organic matter as a meaningful indicator of important soil properties and processes in native forest ecosystems (4.1d, 4.1e).	In progress. Soil samples collected from trial sites for laboratory analysis. Contact: Jurgen Bauhus, Australian National University Phone: 61 (0) 2 6249 2748 Fax: 61 (0) 2 6249 0746

Table 8. cont'd

Title of project (related indicator)	Progress and key contact
Procedures for the measurement of changes in soil physical properties following logging of wet <i>Eucalyptus obliqua</i> forest, and the subsequent effect on site productivity (4.1e).	In progress. Contact: Bill Neilsen, Forestry Tasmania Phone: 61 (0) 3 6233 8225 Fax: 61 (0) 3 6233 8292
Effect of forest harvesting on soil physical properties: developing and evaluating meaningful soil indicators of sustainable forest management in South Eastern Australia (4.1d).	In progress. Contact: Stephen Lacey, State Forests Service of New South Wales Phone: 61 (0) 2 9872 0111 Fax: 61 (0) 2 9871 6941
Development and implementation of landscape metrics for reporting forest fragmentation at field and landscape levels (1.1e).	In progress. Contact: Phil Norman, Queensland Department of Natural Resources Phone: 61 (0) 7 3896 9830 Fax: 61 (0) 7 3896 9858
Identification of species and functional groups that give early warning of major environmental change (1.2c).	In progress. Contact: Rod Kavanagh, State Forests Service of New South Wales Phone: 61 (0) 2 9872 0160 Fax: 61 (0) 2 9871 6941
Development of indicators of genetic diversity in managed native forests (1.3a, 3.1c, 1.1e, 1.2c).	Scoping study concluded, consideration being given to follow-up work. Contact: Gavin Moran, CSIRO Forestry and Forest Products Phone: 61 (0) 2 6281 8211 Fax: 61 (0) 2 6281 8312
Regeneration success measures and monitoring methods for sustainable forest management in native forest (2.1g).	In progress. Contact: John Kellas, Center for Forest Tree Technology — Victoria Phone: 61 (0) 3 9450 8666 Fax: 61 (0) 3 9450 8644
Testing and refinement of AUSRIVAS for the detection, assessment and interpretation of changes in stream diversity associated with forestry operations (4.1f).	In progress. Contact: Bill Neilsen, Forestry Tasmania Phone: 61 (0) 3 6233 8225 Fax: 61 (0) 3 6233 8292
Development of an agreed framework for consultation and for input of indigenous knowledge pertinent to the Montréal indicators for ecologically sustainable forest management at a regional level (6.6a).	In progress. Contact: Alan Black, Edith Cowan University — Western Australia Phone: 61 (0) 8 9400 5844 Fax: 61 (0) 8 9400 5866
Indicators of changes in fundamental ecological processes in forests based on crown condition, landscape function analysis and biotic indicators (3.1c).	Scoping study report submitted — new proposal being considered. Contact: Ken Old, CSIRO Forestry and Forest Products Phone: 61 (0) 2 6281 8211 Fax: 61 (0) 2 6281 8312

Table 9. Tenure of major native forest types

[Indicator 1.1.a — extent of area by forest type and tenure (incorporates indicator 1.1.c)]

Forest type	Tenure area (thousand ha)						Australia (thousand ha)
	Private	Leasehold	Conserved	Other	Multiple- use	No data	
Eucalypt	33 178	50 681	14 961	13 940	10 728	974	124 463
Tall	1 372	583	1 469	110	3 006	4	6 543
Medium	28 640	35 121	9 232	10 178	7 391	888	91 450
Low	988	12 056	658	787	139	72	14 700
Mallee	2 174	2 920	3 602	2 864	193	11	11 764
Unknown	5	(1)	0	(1)	(1)	0	6
Acacia	2 784	8 525	276	608	99	7	12 298
Melaleuca	949	2 560	424	86	45	29	4 093
Rainforest	1 017	414	812	220	1 093	26	3 583
Casuarina	81	919	39	6	6	(1)	1 052
Mangrove	422	118	231	146	1	126	1 045
Callitris	197	300	69	8	292	(1)	867
Other	3 390	2 586	770	582	1 086	22	8 435
Total native forest	42 018	66 103	17 580	15 597	13 351	1 186	155 835
Plantation softwood							931
Plantation hardwood							291
Total plantations							1 222
Total forest							157 057

(0) Area less than one thousand hectares

Note: Column or row total may not add up due to rounding

Source: National Forest Inventory 1998 and National Plantation Inventory 1999

Table 10. Australia — Nature Conservation Reserves, area by forest type and age

[Indicator 1.1.b — Area of forest type by growth stage distribution by tenure (incorporates indicator 1.1.d)]

Forest type	By age (thousand ha)							
	Total forest area	Total area for which age class is known	Establishment 1-10 years	Juvenile 11-30 years	Immature 31-100 yr	Mature 100-200 yr	Senescent > 200 yr	Two (mixed) aged Three or more aged
Rainforests	812	177.0				177		
Tall open eucalypt	1 435	184.9	0.1	5.2	19.4	95		19 46.2
Medium open eucalypt	3 388	756.3	0.1	0.5	41.0	203		49 462.7
Low open eucalypt	17							
Tall eucalypt	34							
Medium eucalypt	5 844							
Low eucalypt	641							
Eucalypt mallee	3 602							
Callitris	69							
Acacia	276							
Other	1 463	31.0						31.0
Total	17 580	1 149.2	0.2	5.7	60.4	475	0	68 539.9

Notes:

1. For Nature Conservation Reserves, New South Wales did not provide age-class information by forest type, so the State's data is not included in this national sum.

2. New South Wales reports on the six eucalypt forest types combined, which total an area of 655 017 ha, composed of three age classes (75 980 ha of juvenile, 475 095 ha of senescent and 103 942 ha of immature and mature combined).

3. Tasmania merges all age class data for mature and senescent and reports it under mature.

Source: National Forest Inventory 1998

Table 11. Australia — Multiple-use forests by forest type and age

[Indicator 1.1.b — Area of forest type by growth stage distribution by tenure (incorporates indicator 1.1.d)]

Forest type	By age (thousand ha)							
	Total area for which age class is known	Establishment 1–10 years	Juvenile 11–30 years	Immature 31–100 yr	Mature 100–200 yr	Senescent > 200 yr	Two (mixed) aged	Three or more aged
Rainforests	341				195	80		66
Tall open eucalypt	1 984	73	150	273	378	364	133	614
Medium open eucalypt	2 971	22	150	147	647	266	171	1 568
Low open eucalypt								
Tall eucalypt								
Medium eucalypt	1 360					546		814
Low eucalypt								
Eucalypt mallee								
Callitris	225							225
Acacia								
Other	74							74
Total	6 955	95	300	420	1 219	1 256	304	3 361

Note: State definitions of forest types may differ from each other and from the national definitions, potentially resulting in different categorisations.

Source: National Forest Inventory 1998

Table 12. Number of species known to occur in Australian forests

[Indicator 1.2.a — A list of forest dwelling species]

Species known to occur in forests	Number of species
Mammals	317
Birds	561
Reptiles	219
Amphibians	126
Fish	16
Higher plants	13 622
Rare or threatened vertebrates	81

Source: National Forest Inventory 1998

Table 13. Area of native forest under multiple-use forest tenure available for harvesting, by State and Territory [Indicator 2.1.a — Area of forest land and net area of forest land available for timber production]⁽¹⁾

	Total multiple-use forested (thousand ha) ⁽²⁾	Percentage forested of total multiple-use ⁽³⁾	Total multiple-use area (thousand ha) ⁽⁴⁾
Australian Capital Territory	5	20.2	23
New South Wales	3 095	81.1	3 814
Northern Territory	—	—	—
Queensland	3 983	91.7	4 346
South Australia ⁽³⁾	27	21.0	126
Tasmania	1 285	79.0	1 627
Victoria	3 346	90.2	3 710
Western Australia	1 612	82.1	1 962
Australia	13 351	85.5	15 608

Notes:

(1) Does not include timber production data from private and other tenures

(2) Forested portion of multiple-use forests. Percentages relate to exact figures, not the rounded figures given in this table

(3) Includes unforested areas

(4) No harvesting of publicly owned native forest takes place in South Australia.

Column or row total may not add up due to rounding.

Source: National Forest Inventory 1998.

Future Activity

Australia recognises that the implementation of criteria and indicators will require significant effort in the future. The key challenges are to address a number of major impediments, including the following:

- Lack of consistency and different methods of data collection and format among States
- Poor or no data from non-commercial forests on public land and from essentially all forests on privately managed land
- Lack of knowledge and commitment to criteria and indicators by private forest growers and lessees
- Lack of integration of RFA data into indicator format
- Amount of research and development required to implement some of the indicators
- Scarcity of resources for removing these impediments and advancing progressing implementation.

However, even with these impediments, Australia considers that significant progress has been made since 1997. In particular, there is better co-ordination across activities at both the State or Territory and national levels, as well as recognition that duplication needs to be removed.

Australia's regional framework is, and will continue to be, viewed as a dynamic document that can reflect variables such as changes in community expectations and improvement in knowledge. One of the key tasks for the future, in the implementation of indicators at a regional level, is the need to develop objectives, targets and standards in accordance with management requirements and objectives against which trends in indicators can be measured.

In terms of reporting, the following commitments will utilise data collected for the regional framework of indicators:

- Category A indicators (regular national reporting with first scheduled for 2000)
- National State of the Environment Report (2001), supported by State and Territory level reports
- State of the Forests Report (2003)
- Montréal Process Report (2003)

Internationally, Australia continues to participate in the Montréal Process Working Group and its Technical Advisory Committee. We believe opportunities exist for sharing experiences with other countries both within the Montréal Process and more broadly, and will continue to promote such co-operation.

Further information is available at the following web sites:

<http://www.affa.gov.au/ffid/sir/criteria/>

<http://www.fwprdc.org.au>

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- Australian Bureau of Statistics. 1995. *Australia Year Book*. AGPS, Canberra
- Commonwealth of Australia 1997, *Australia's First Approximation Report to the Montréal Process* — June 1997, Montréal Process Implementation Group, Australia
- National Forest Inventory 1998, *Australia's State of the Forests Report 1998*, Bureau of Rural Sciences, Canberra
- National Plantation Inventory 1999, *National Plantation Inventory 1999 — The Tabular Report*, Bureau of Rural Sciences, Canberra (only available through the website: www.brs.gov.au/nfi/activities/npi/interim.html)

Vignette on Canada

Canada's Forests

Canada is known for the abundance of its natural resources and, in particular, the vastness of its forests—nearly half the nation's land area. Our forests are part of our heritage and national identity, and are viewed as a legacy to be sustained and passed on. These living, life-supporting ecosystems provide Canadians with ecological and environmental services, as well as economic and social benefits ranging from the material to the spiritual.

Canada is unusual among forest nations in that most of its forests are publicly owned and are overseen by governments. Seventy-one per cent of the forests are under provincial jurisdiction, 23 per cent are under federal jurisdiction (some managed by or in co-operation with the territorial governments), and the remaining 6 per cent are in the hands of an estimated 425 000 private landowners.

Under the Canadian Constitution, the provinces retain responsibility for forest management, and each province has its own legislation, regulations, standards and programs through which it allocates harvesting rights and management responsibilities for the public forest. In the Northwest Territories the responsibility for forest management has been transferred from the federal to the territorial governments and a similar transfer is being negotiated with the Yukon Territory. In recognition of the broad spectrum of forest users, governmental agencies seek public views and work closely with forest industries, Aboriginal groups and environmental organisations to incorporate recreational, social, wildlife and economic values into forest management planning and decision-making.

In ecological terms, there are eight forest regions in Canada, ranging from the tall towering coastal rainforests in British Columbia to the sparse, slow-growing forests at the Arctic tree line. Each region has a distinct distribution of plant and animal species; an estimated 180 species of trees occur in different parts of the country. Canada can also be described as having 15 terrestrial ecozones, 194 ecoregions, and more than a thousand ecodistricts.

The forests were once viewed primarily as sources of timber, and forestry was based on the economics of harvesting. Today, forest management also includes economic, environmental, social and cultural considerations. To find flexible and balanced ways of integrating these factors — a challenging task given the complexity and size of the resource and the diverse interests of the forest community — Canada is continually re-examining and adjusting its policies and engaging its collective ingenuity to sustainably manage its forests. Criteria and indicator (C&I) initiatives, at both the national and international levels, are key components of Canada's efforts to measure and report on sustainable forest management (SFM).

Measuring Sustainable Forest Management at the National Level

With the global shift in approach from sustained yield to SFM, Canada has faced a variety of new demands:

- The need to broaden traditional forest policies and practices to integrate many non-timber, as well as timber, values
- The need to develop a better understanding of how forest systems work from ecological, social and economic perspectives
- The need to encourage co-operation and partnerships among a broad range of forest users
- The need to define a set of forest values for the nation to adopt, sustain and enhance.

In addition to its participation in the Montréal Process, Canada has taken a number of steps domestically to promote SFM. In early 1992 — a few months prior to the UN Conference on Environment and Development and after two years of national consultations — Canada's forest community and the public agreed that science-based C&I were an important tool in achieving SFM. This agreement was subsequently reflected in the National Forest Strategy, *Sustainable Forests: A Canadian Commitment (1992–1998)*, which included 96 action items to guide forest management.

In 1993, the Canadian Council of Forest Ministers (CCFM) began an initiative to measure and report on forest values that Canadians consider important, and in 1995, after year-long consultations, the council adopted a national framework of C&I. This framework reflects an approach to forest management that recognises forests as ecosystems providing a wide range of environmental, economic and social benefits to Canadians.

CCFM C&I Framework

- Criterion 1: Conservation of Biological Diversity (8 indicators)
- Criterion 2: Maintenance and Enhancement of Forest Ecosystem Condition and Productivity (12 indicators)
- Criterion 3: Conservation of Soil and Water resources (8 indicators)
- Criterion 4: Forest Ecosystem Contributions to Global Ecological Cycles (20 indicators)
- Criterion 5: Multiple Benefits of Forests to Society (16 indicators)
- Criterion 6: Accepting Society's Responsibility for Sustainable Development (19 indicators)
- * The framework is divided into 22 elements, and from those elements, 83 indicators have been established to measure the nation's progress toward sustainable forest management.

The intention of the CCFM in developing the C&I framework was to:

- Clarify the meaning of SFM and provide a framework for describing and assessing it at a national level
- Provide a reference point for the development of policies on the conservation, management and sustainable development of forests
- Contribute a scientific and policy basis for the clarification of issues related to environment and trade, including product certification
- Provide concepts and terms to facilitate domestic and international dialogue on SFM
- Improve the information available to the public and decision-makers.

An analysis of the CCFM C&I framework and the Montréal Process framework has indicated that the two systems are compatible, with approximately 80 per cent similarity. Although the CCFM indicators reflect the particular features of Canada's forests, the CCFM criteria are consistent with the first six criteria of the Montréal Process. Some of the indicators under criteria 5 and 6 of the CCFM framework are similar to those found under the seventh criterion of the Montréal Process (legal, institutional and economic framework for forest conservation and sustainable management).

In 1997, on behalf of the CCFM, a network of forest experts from the provinces and territories, industry organisations, non-governmental organisations, academic institutions and professional forestry associations prepared a detailed document that described Canada's capacity to report on each of the 83 indicators. That document was entitled *Criteria and Indicators of Sustainable Forest Management in Canada, Technical Report*. To communicate the network's findings to a broader audience, a more concise and less technical version of the report also was released, entitled *Criteria and Indicators of Sustainable Forest Management in Canada, Progress to Date*. Preparation of these two reports led to a better understanding of Canada's strengths and weaknesses with respect to our capacity to measure forest sustainability.

In 1998, Canada renewed its commitment to sustainable forests in the *National Forest Strategy (1998–2003)*. In particular, the new Strategy addresses the need to develop objective measures for testing and demonstrating sustainability under the national framework of C&I, and it commits to action plans for regular reporting on Canada's progress toward SFM. (Canada will report on its progress in April 2000, at the United Nations Commission on Sustainable Development in New York City.)

Implementing Criteria and Indicators at the Sub-national Level

Under the National Forest Strategy, several provinces have adopted provincial sets of C&I, and many are preparing to incorporate them into their forest management planning. In addition, some provinces have taken steps to integrate C&I into their forest legislation, while others are considering that possibility. Quebec, for example, amended its Forest Act to include the six criteria from the CCFM C&I framework and has developed a framework of 60 indicators (many of which are similar to those of the CCFM) which it expects to implement over a three-year period. Ontario, too, has drafted a comprehensive set of indicators for use at the provincial level in evaluating and reporting on forest sustainability. In both of these provinces, the C&I have been integrated into forest legislation and policies.

In Newfoundland and Labrador, the government is drafting a 20-year forestry development plan that will contain specific references to a provincial set of C&I, and it is considering having the indicators integrated into legislation.

In addition, Saskatchewan is developing indicators for forest ecosystem health that are derived mainly from the Montréal Process. And New Brunswick has taken a slightly different approach, developing a vision document for its forests that provides a framework for forest management and sets out policy goals, as well as explicit standards and objectives to be used in the development of forest management plans on Crown Timber Licences.

Developing and Testing Criteria and Indicators at the Local Level

Canada's Model Forest programme was established in 1992 by Natural Resources Canada-Canadian Forest Service to develop and demonstrate innovative approaches to SFM. At the core of each model forest is a partnership of people who collaborate in working toward their shared objective of SFM within the social, economic and ecological conditions of their own forest area. (Together, the network of 11 model forests represents the diversity and complexity of the major forest regions of Canada.)

An important focus for each model forest in Phase II of the programme (1997-2002) was the establishment of processes for the development, testing, application and monitoring of local-level indicators of SFM, based on the CCFM C&I framework. The guidelines for the indicators' development required that they be based on appropriate scientific attributes; be easily and readily measured; demonstrate the best management practices available; be adaptive, replicable by others and relevant on a temporal basis (reflecting links between changes in economic, social and environmental circumstances); and be able to show trends in behaviour and attitudes.

The suites of local-level indicators can be used by each of the model forests to describe its progress toward SFM. In addition, a network-wide initiative is enabling the model forests to share their experiences, expertise and information and help each other achieve their own suites of local-level indicators. As of 31 March, 1999, each model forest had developed a set of indicators. Although some sites are in the process of refining their initial master set, several are beginning to develop protocols for monitoring and reporting the indicators.

This approach to developing suites of local-level indicators has been adopted by various industries and provincial governments. Currently, Newfoundland, Manitoba and Alberta are using and supporting the model forest process to develop regional and provincial indicators. Also, partner industries at Manitoba Model Forest, Fundy Model Forest and Foothills Model Forest are adopting these approaches for their forest management planning and are linking the indicators to their certification requirements.

New Rules and Regulations

Across the country, new forest laws based on the principles of sustainability and stricter enforcement of policies and guidelines indicate that steps are being taken by an increasing number of provinces and territories in response to the demands of SFM. For example, in recent years, many provinces have passed legislation or introduced regulations governing forestry operations on Crown land.

British Columbia, for instance, has opted to address most of the aspects covered under the C&I through legislation, administration and research. Alberta has developed a framework that reflects the public's desire to maintain its access to the wide range of benefits provided by sustainable forest ecosystems. In addition, a number of provinces have announced incentives to encourage the sustainability of private woodlots through tax rebates, financing for silvicultural activities and education.

Government agencies across Canada have, without exception, adopted a consultative approach to developing forest policy. They routinely seek public views and work closely with industries, Aboriginal groups and environmental groups to incorporate recreational, social, wildlife and economic values into forest management planning and decision-making.

New Data Collection Systems

In establishing and reporting on the CCFM C&I framework, Canada has faced challenges in developing new approaches to data collection and management (particularly for non-timber values), in developing tools to measure social values and in expanding its knowledge of forest ecosystems. With respect to new approaches to data collection and management, a number of initiatives have evolved in response to C&I demands.

A new National Forest Inventory is being proposed that will be consistent nationally, describe all classes of ownership, provide changes and trend estimates, be compatible with ecological classification and allow spatial and temporal reporting on multiple resource attributes. For the past decade, the forest inventory for Canada has been prepared by rolling up data from provincial inventories, based on definitions that were not always compatible. Approximately 30 per cent of the indicators in the CCFM framework will be addressed in the national inventory. In addition, some non-timber values will be incorporated, such as the number of forest-dependent species.

To complement the new inventory, a National Forest Information System has also been proposed, as a national system for integrating and linking information on Canada's forests. In addition, the Canadian Forest Service is working with the Canadian Space Agency on a joint project called Earth Observation for Sustainable Development (EOSD). The project is designed to monitor the sustainable development of Canada's forests and provide core information requirements. It is estimated that the reporting requirements of 25 of the 83 indicators could potentially be satisfied through this remote sensing project.

Future Reporting

The pursuit of SFM is a dynamic and evolving process. Criteria and indicators are based on the best information available and, as such, they are subject to continual revision and improvement. For example, several years have passed since the CCFM C&I framework was developed, and during that period, the capacities of information systems have increased, the approaches to forest inventories have changed and the availability of data for some indicators has improved. Also, advances in science have increased our understanding of systems and have influenced our concept of SFM and our ability to measure our progress toward that objective.

It is in this light that the CCFM has approved a review of the 83 indicators currently included in the C&I framework. In addition, the Council has used the experience and knowledge gained from the preparation of Canada's first report to develop and approve an implementation plan for reporting in 2000.

The Task Force charged with preparing the implementation plan has identified a core set of 49 indicators, which they derived from the original 83 indicators by conserving those consistent with ones found in other C&I processes, combining similar indicators, and focusing on indicators applicable at the national level. (In fact, close to 70 indicators from the original framework will be reported on in 2000.)

To carry out the implementation plan and facilitate production of the 2000 report, the Task Force established working Internet and FTP sites. By providing templates for data submission and compilation, these sites have served to standardise the submission of data and information. In addition, by linking the 75 technical contacts across the country who provide the information for the report with the 22 writers who compile the national perspectives for the indicators, the sites have also stimulated discussion regarding definitions and reporting strategies, and have promoted the sharing of information and ideas. The working web site also will be used to identify sources of information and to archive information for future reporting.

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Vignette on Chile

Introduction

Chile is situated in the southwest part of South America, extending southward to the Antarctic continent and westward as far as Easter Island. On the South American continent, it stretches from 17 degrees 30 minutes latitude south to the Diego Ramirez islands at 56 degrees 30 minutes latitude south. The country has a continental surface area of 75.4 million hectares, of which 15.6 million hectares are classified as forests (20.8 per cent) as recorded in the 1998 Natural Vegetation Survey.

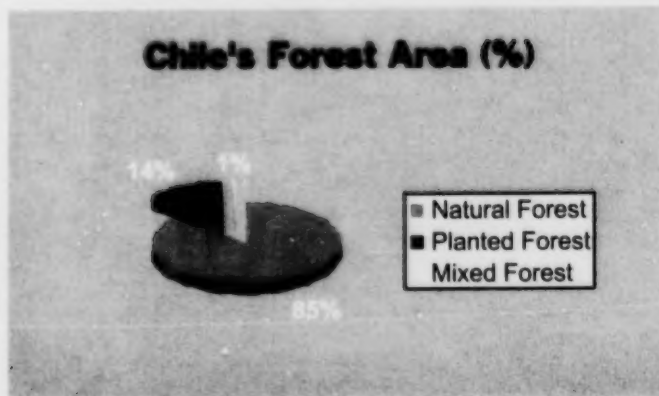
As a result of this geographical scope, there is a wide variety of climatic types, prominent among them desert, steppe, Mediterranean, warm rainy temperate, rainy maritime, cold steppe, tundra and polar climates. With this geographical scope, the variety in latitude and altitude makes it possible to find in Chile a diversity of plant formations. Studies including one by Gajardo in 1994 have determined that there are eight vegetation regions and 21 vegetational subregions.

Chile is divided into 13 political-administrative Regions, nine of which contain temperate forest resources and tree plantations. The four northernmost regions are extremely arid and have scanty woodland areas that do not contain temperate forests.

The Ministry of Agriculture is responsible for the development of policies for promotion of the country's agriculture, livestock and forests. The Ministry performs its forest management and conservation functions in accordance with its legal authority and with a number of provisions that enable it to operate through Services or Agencies. These are dependent on the national government, but they are administratively and geographically decentralised. In this respect, the Forest Service (CONAF) is an agency that belongs to the Ministry of Agriculture. Its institutional mission is "To guarantee for society the sustainable use of forest ecosystems and the efficient management of the National System of State-Protected Areas (SNASPE), for the purpose of contributing to the improvement of quality of life for present and future generations."

The forest resources existing in Chile consist of native forests, planted forests and a mixture of both, with a total surface area of 15 647 894 hectares (Natural Vegetation Survey, CONAF-CONAMA, 1998) (Figure 3).

Figure 3. Composition of Chile's forest



National Initiatives that Promote the Montréal Process

National Survey of Native Vegetational Resources

Since 1997 Chile has had a National Survey of Native Vegetation Resources and a land use information system, tools that facilitate the monitoring of changes in forest area and the construction of area-based indicators which are present in the Montréal Process.

The instrument makes it possible to do the following:

- Locate, determine dimensions and to a certain degree, characterise the forests and the various natural plant formations existing in the country
- Set up a digital database for expeditious handling and updating of information on the natural plant formations and planted forests existing in the country
- Monitor changes in land use and update the pertinent information.

Inasmuch as the objective of the Survey is an evaluation for environmental and economic purposes, the definitions used pertain to concepts based fundamentally on the structure of ecosystems or communities more than on concepts related to utilisation. This establishes a high degree of compatibility with the Montréal Process, whose *Introduction* states, in point 1.3, that "The forest management approach reflected in the criteria and indicators is the management of forests as ecosystems." This conceptual approach of both instruments makes it possible to implement the Montréal Process indicators with a high degree of correlation.

It is estimated that 28 of the total of 67 indicators of the Montréal Process can be applied based on the Survey. However, and in line with the "Design of a System for Follow-up and Monitoring of the State of Conservation of Native Formations" project, the development of the indicators listed under Criterion 1 will be given priority (Table 14).

Table 14. Relation of Montréal Criterion 1 to Chile's Survey

Montréal Criteria and Indicators	Degree to which the Survey and its updates serve the purpose
Criterion N° 1	
Conservation of Biological Diversity	Partially
<u>Ecosystems diversity</u>	Partially
• Area by forest type in relation to total forest area	Fully
• Area by forest type and by age class or succession stage	Partially
• Area by forest type in Protected Areas	Fully
• Area by forest type in Protected Areas and by age class or succession stage	Partially
• Fragmentation of forest types	Partially
<u>Species diversity</u>	
• Number of forest-dependent species	Partially
• Conservation status of forest-dependent species	Fully
<u>Genetic diversity</u>	
• Number of forest-dependent species which occupy a small part of their original distribution range	Partially
• Population levels of species representative of diverse habitats, measured periodically and systematically throughout their distribution range	Partially

31

The indicators that can be fully measured or calculated on the basis of information contained in the Survey of Native Vegetational Resources will be available in CONAF's Inquiry System, through a subsystem. Thus, for instance, it will be possible to ask for indicator (a) of Criterion 1 Conservation of Biological Diversity — in other words, area by forest type in relation to total forest area at the level of a protected area, a commune, a province, a region or the entire country.

Furthermore, it will be possible to measure the indicators listed under Criterion 2 once the Forest Information System is developed (Table 15). This is a system that will integrate data from CONAF's Survey of Native Vegetation from a National Survey of Planted Forests prepared by the Forestry Institute (INFOR).

Table 15. Relation of Montréal Criterion 2 to Chile's Survey

Montréal Criteria and Indicators	Degree to which the Survey and its updates serve the purpose
Criterion N° 2	
Maintenance of the productive capacity of forest ecosystems	Partially
• Area of lands suitable for forestry and net area of woodlands available for timber production	Fully
• Area and volume of plantations of native and exotic species	Fully

At present, changes in land use are monitored and the information is updated. This will make it possible to have a platform upon which to begin to construct the proposed indicators.

Permanent Working Group for Sustainable Management of Chile's Forests

In 1996, the Permanent Working Group for Sustainable Management of Chile's Forests (GMS) was formed, as collaboration with a project prepared by the Forestry Institute (INFOR). Also participating, as founding members of the GMS, were the Forest Service (CONAF); the Chilean Wood Manufacturers Association (CORMA), an organisation made up of the country's main forest companies; the National Commission for the Environment (CONAMA); and the Ministry of Foreign Affairs. At present, the group also includes university representatives, environmental organisations, the forest engineers association and the small farmers association. One of the specifically defined courses of action is the search for consensus regarding sustainable forest management (SFM).

With the aim of attaining this consensus, an instrument was designed which consists of a set of assertions that reflect, to a greater or lesser degree, what the different players think of SFM.

Concepts expressed in various international and national initiatives, both public and private in nature, were used in the preparation of this questionnaire, the Montréal Process being one of the foundations supporting the development of this tool.

The work of this group has not yet finished, but nevertheless the progress attained has already made it possible to approach a level of agreement between the parties.

Application of Criteria and Indicators at the Local Level

CONAF's Environmental Studies Unit is developing a proposed method for the common understanding and evaluation of SFM, backed by the framework of criteria and indicators of the Montréal Process.

The idea is that, based on a criterion, one can arrive at a performance objective or goal which, in accordance with the standard or norm, can be incorporated into the forest management plan for evaluation in the field. In themselves, the criteria and indicators constitute a key component of the cycle of continuous improvement of SFM, inasmuch as they can be converted into practical objectives and means of measuring performance, for the purpose of incorporating them into forest planning, operating decisions and monitoring systems.

The method is designed to facilitate the operational application of SFM concepts, and with this the designing, management and evaluation of the sustainability of plans, programmes and projects at national and sub-national levels (region, province, commune or forest management unit).

At present there are two projects, headed by government agencies with the backing of international co-operation organisations, whose follow-up and monitoring plans include the use of some indicators derived from the Process for the evaluation of SFM at the local level. They are being developed for demonstration purposes, and are:

- Conservation of Chile's Temperate Natural Forest, Environmental Criteria for Sustainable Management, Application to the Pilot Area: Malleco Forest Reserve, Tolhuaca National Park, and their Peripheral Area (CONAF/National Forest Office of France agreement), this project involves an area of approximately 30 000 hectares
- Management Plan for the Valdivia National Reserve, this is part of a project on the Sustainable Management of Natural Forests (CONAF/German Technical Co-operation Society, GTZ, agreement), and involves an area of approximately 16 000 hectares.

Management of National Forest Reserves

Innovations are being introduced in management and harvesting within the National Reserves. These innovations are in line with the principles that will guide forest development in the 21st Century, and are based on the criteria of the Montréal Process. They aim to offer present and future generations a forest heritage that is biologically and ecologically stable, highly productive, and of great adaptability in the face of changes in the environment and in social demands. The sustainable utilisation of natural resources is promoted, combining production of goods and services with the needs of the nearby peasant and indigenous communities, as well as the demands of the increasingly urban population of the country.

This new forest management model will have the following fundamental objectives:

- Sustainable production, ensuring the permanent existence of well-managed forests, adapted to the site
- Protection or recovery of the biodiversity
- Social development based on a participatory process including the communities linked with the forest or forest activities
- Appreciation of the natural forest by the national community.

Chiloe Model Forest

Chile, with its "Chiloe Model Forest," has been part of the International Model Forest Network since 1998. The strategic vision of the Chiloe Model Forest proposition is to increase utilisation of the natural resources associated with forest ecosystems, maintaining the ecological characteristics and processes of these systems. Key components are the search for, development, and implementation of, new and innovative approaches, practices and technologies. These would be based on the generation of a solid knowledge base on the dynamics of the ecosystems involved and their characteristics, functions and interrelations, as well as on the participation and recognition of the interests and viewpoints of all the social groups interested in the forests or dependent upon them. Thus, combining scientific knowledge, an ecological approach and a social approach, it is possible to develop and apply a system of integrated management of the natural resources, which is accepted by all stakeholders.

Among the objectives of the Chiloe Model Forest is that of providing support in the development and application of criteria and indicators. To this end, it has incorporated into its negotiation and implementation of SFM, the concepts developed by the Montréal Process.

A first evaluation will be made to determine the degree of fulfilment attained which will make it possible to obtain feedback for the purpose of improving the project.

Forest Contribution to Global Carbon Cycles

Chile is a signatory country to the Framework Convention on Climate Change (FCCC). There are many commitments that are common to FCCC and the Montréal Process criteria and indicators.

Regarding Criterion 5, it is relevant to mention that there is an important government-funded research project aimed at developing methodologies to determine the carbon status of planted and indigenous forests, considering different species and forest types. The results of this project will enable Chile to report on this criterion by the year 2002-03.

Legal, Institutional and Economic Framework

At present, there are two legal initiatives being discussed in Parliament. The first proposes a new institutional framework, in order to enhance the capacity of the governmental agencies to deal with the development of the forest sector and particularly to promote the sustainable management of indigenous and planted forests. With this new institutional framework the forest sector aims to acquire a higher rank within the Government structure; the bill proposes the creation of an Under-secretary of Forest Development and a Forest Service with new mandates.

The second legal initiative under discussion is aimed at promoting the recovery and management of Chile's indigenous forests. This Act should be the main mechanism to promote SFM.

Conclusions

The application of the Montréal Process concepts in Chile has not been free of difficulties. Nevertheless, the progress since the signing of the "Santiago Declaration" has been significant. Following dissemination and discussion within the Forest Service and with other players in Chile's forest sector, this process has served as a conceptual framework for developing initiatives designed to further the sustainable management of temperate forests in Chile.

The experience arising from these and other initiatives consistent with the Montréal Process will serve to strengthen a harmonious development, which will contribute to the sustainability of the country.

Vignette on China

Summary

The *status quo* of development and implementation of criteria and indicators for sustainable forest management in China has been reviewed. China is one of the 12 member countries of the Montréal process and has been participating in other international initiatives. The Chinese Government has taken a series of significant measures in promoting sustainable forest management (SFM). The *Forestry Action Plan for China's Agenda 21*, the *Outline of China's Ecological Development Programme*, and the *Action Plan of Protection of Biodiversity in China* have been worked out, and relevant researches, capacity building and extension have been carried out.

In order to effectively implement SFM in China, a research group to develop the criteria and indicators for such management has been established. Research in experiment and demonstration regions has been initiated to test and further develop the criteria and indicators and final versions will be formulated which could be operational and meet the need at the various levels.

The development of criteria and indicators for SFM is an important step in implementing the *Forestry Action Plan for China's Agenda 21*. The criteria and indicators will be formulated on the basis of specific Chinese conditions, and fully standardised components will be drawn from relevant criteria and indicators, designed to be in line with those adopted internationally, especially in the Montréal Process. There are many constraints existing in the formulation of criteria and indicators for SFM, and arduous tasks will be faced to implement them in China.

Forests in China

The largest forests are in the northeast and inner Mongolian provinces, the 10 southern provinces, and Sichuan and Yunnan provinces. The Chinese Government attaches great importance to forestry development. China has the world's most extensive plantation estate, in excess of 20 million hectares.

China is one of the most species-diverse countries in the world. There are about 32 800 flowering plant species, of which 9 410 are woody species, comprising 40 per cent of the world total. The forests and other vegetation are home to about 499 species of mammals, 1 244 species of birds, 391 species of reptiles, 280 species of amphibians and millions of invertebrates. Furthermore, this country is one of the three major centers of origin of cultivated plants in the world, with a number of related wild species. There are approximately 870 nature reserves covering more than 6 per cent of the country's land area.

In China, about 58.2 million hectares or 45.3 per cent of the total forest cover are State owned and administered by the State Forestry Administration, and 70.3 million hectares or 54.7 per cent are owned by collectives, although managed under the authority of forest laws and monitored by the State Forestry Administration. However, the growing stock of the collective-owned forest resources is only 32.2 million cubic metres or 30 per cent of the total growing stock in China, compared with 70 per cent from State forest lands. Forestry activities are labour intensive and the sector is a large employer of both men and women, with more than 2.5 million employees.

China is a developing country with a population of more than 1.26 billion, which accounts for about 20 per cent of the world population. The country lacks forest resources, with only 13.92 per cent forest cover and 3 to 4 per cent of the world's forest area. China's forests can hardly meet the basic living needs of its population, environmental conservation and improvement. The pressure will be more and more intense with successive increases in an already huge population and an increasing standard of consumption per capita.

Criteria and Indicators at the National Level in China

Sustainable forest management had been developing as an important issue of common concern when it emerged at the United Nations Conference on Environment and Development (UNCED) in 1992. As a follow-up action to UNCED, *China's Agenda 21 — A White Paper on China's Population, Environment and Development into the 21st Century* was drafted by the Chinese Government as one of the key documents to guide the country's long-term plan of social and economic development. Sustainable forest management gained great attention in terms of realising sustainable development. Under the guidance of the principle of sustainable development, the *Forestry Action Plan for China's Agenda 21* was worked out, and priority project items of the Forestry Action Plan were formulated by the former Ministry of Forestry. These were highlighted as major documents presenting the components and the objectives in the national Ninth Five-Year Plan and the Plan for the year up to 2010. Recently, in 1999, *China's national program for ecological environment improvement* was worked out by the Chinese Government, which is for long-term guidance and alignment with the national economic and social development plan.

An important aspect of implementing sustainable forest management in China is to improve environmental services and supplies of products of the forest ecosystems. This is being done through the establishment of high yield plantations, an ecological protection forest system and restoration of degraded forest ecosystems. Achieving this will require an increase in forest resources and a reduced consumption from the natural forests. Since 1978, large-scale protection forest programmes have been implemented including the Three-North (namely Northwest, Central-north, and Northeast) Shelterbelt System, the Soil and Water Conservation Forests Along the Upper and Middle Reaches of the Yangtze River, the Coastal Shelterbelt System, the Taihang Mountain Afforestation, the Farmland Shelterbelt Network in Plains Areas, and the National Combat against Desertification. So far, approximately 21.86 million hectares of protection forests have been established. Remarkable achievements have been made in these programmes, but there is a wide gap remaining to be closed for the completion and full functioning of the ecological protection forest system and the realisation of SFM across China. Therefore, as well as continuously implementing the above-mentioned forestry programme, the following new programme was started in early 1998, that is, the Soil and Water Conservation Programme Along the Upper Reaches of Yangtze River, the Soil and Water Conservation Programme Along the Middle and Upper Reaches of the Yellow River, and the Natural Forest Conservation Programme in Key Natural Forest Areas. These programmes are intended to improve the ecological environment in these regions, better distribute China's system of ecological forestry programme and strengthen the capacity for implementing SFM.

The development of criteria and indicators for sustainable forest management is an important step in implementing the UNCED "Forest Principle", Agenda 21 and the Forestry Action Plan for China's Agenda 21, which is relevant to the protection of biological diversity, climate change and prevention of desertification. Criteria and indicators are the basis for constructing the evaluation system for sustainable forest development, and the standard and basis for evaluating and judging forestry economic activities within the range of forestry development. Formulating the standardised and operational criteria and indicators for SFM is essential to improve the application of sustainable forestry development in China.

Under the unified leadership of the State Forestry Administration, formulation of criteria and indicators was put into effect by Sustainable Forestry Research Center, Chinese Academy of Forestry. With involvement of experts from various fields, a provisional *Framework of Criteria and Indicators for Sustainable Forest Management in China* has been worked out (Table 16), and it is now under testing and further development. There are 8 criteria and 80 indicators in the set of China's national-level criteria and indicators, of which 11 indicators are ready to be implemented, 55 require some Research and Development, 9 require long-term Research and Development and 5 are uncertain.

Table 16. Framework of National Level Criteria and Indicators for Sustainable Forest Management in China

China's Framework			Montréal
Ref.	Criteria and Indicators	Type*	Process Ref.
1	Conservation of Biological Diversity		1
1.1	Ecosystem diversity		1.1
1.1.1	Extent of area by forest types relative to total forest area	A	1.1.a
1.1.2	Extent of area by forest type and by age class or successional stage	B	1.1.b
1.1.3	Area and per cent of plantation by broad/leaved species and coniferous species	B	NA
1.1.4	Extent of area by forest type in protected area categories as defined by IUCN or other classification systems	B	1.1.c
1.1.5	Extent of area by forest type in protected area categories and by age class or successional stage	D	NA
1.1.6	Fragmentation of forest types	C	1.1.d
1.2	Species diversity		
1.2.1	Number of forest-dependent species	B	1.2.a
1.2.2	Status of forest-dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment	A	1.2.b
1.3	Genetic diversity		1.3
1.3.1	Number of forest-dependent species that occupy a small portion of their former range	B	1.3.a
1.3.2	Population levels of representative species from diverse habitats monitored across their range	C	1.3.b

*Indicator type: A-implementation now; B-requiring some R&D; C-requiring long-term R&D; D-uncertain

Table 16. cont'd

China's Framework			Montréal Process Ref.
Ref.	Criteria and Indicators	Type*	
2	Maintenance of the Productive Capacity of Forest Ecosystems		2
2.1	Area of forest land and net area of forest land available for timber production	A	2.a
2.2	Area and total growing stock of different forest types	B	NA
2.3	Ratio of different types of forest land in the total forest land	A	NA
2.4	Total growing stock of forests for timber	B	2.b
2.5	Area and growing stock of plantations	B	2.c
2.6	Distribution of area and stock of forest for wood production by age-class	B	NA
2.7	Annual cutting of forest for timber not to exceed the annual growth of forests	A	cf. 2.d
NA	Annual removal of wood products compared with the volume determined to be sustainable	N/A	2.d
2.8	Annual removal of non-timber forest products (fur-bearers, berries, mushrooms, game), compared with the levels determined to be sustainable	B	2.e
3	Maintenance of Forest Ecosystem Health and Vitality		3
3.1	Area and per cent of forest affected by process or agents beyond the range of historic variation	B	3.a
3.2	Area and per cent of air polluted	A	cf. 3.b
NA	Area and per cent of forest land subject to levels of specific air pollutants or ultraviolet B that may cause negative impacts on the forest ecosystem	N/A	3.b
3.3	Area and per cent of forest land with diminished biological components indicative of changes in fundamental ecological process and/or ecological continuity	B	3.c
4	Conservation and Maintenance of Soil and Water Resources		4
4.1	Area and per cent of forest land with significant soil erosion	B	4.a
4.2	Area and per cent of cultivated land on slopes of more than 25 degrees which has been turned back into forest land	B	NA
4.3	Area and per cent of forest land for soil and water conservation in those important regions	B	cf. 4.b
NA	Area and per cent of forest land managed primarily for protective functions	N/A	4.b
4.4	Per cent of stream kilometres in forested catchment in which stream flow and timing have significantly deviated from the historic range of variation	C	4.c
4.5	Range of changes in physical and chemical properties of streams in forested catchments	C	cf. 4.f & 4.g
NA	Per cent of water bodies in forest areas with significant variance of biological diversity from historic range of variability	N/A	4.f

*Indicator type: A-implementation now; B-requiring some R&D; C-requiring long-term R&D; D-uncertain

Table 16. cont'd

China's Framework			Montréal Process Ref.
Ref.	Criteria and Indicators	Type*	
NA	Per cent of water bodies in forest areas with significant variance from historic range of variability in pH, dissolved oxygen, levels of chemical, sedimentation or temperate change	N/A	4.g
4.6	Controlled area and control percentage of areas with soil and water losses, intensity of which is very light	B	NA
4.7	Controlled area and control percentage of areas with soil and water losses, intensity of which is light	B	NA
4.8	Area and per cent of cultivated land on slopes on which maintenance and conservation of soil and water resources have been taken into account according to regulations of the government	B	NA
4.9	Area and per cent of forest of human origin which has serious degradation of site index	C	cf. 4.d & 4.e
NA	Area and per cent of forest land with significantly diminished soil organic matter or changes in other soil chemical properties, or both	N/A	4.d
NA	Area and per cent of forest land with significant compaction or changes in soil physical properties resulting from human activities	N/A	4.e
4.10	Area and per cent of broad-leaved forest in forests of human origin	A	NA
4.11	Area and per cent of individual tree species	A	NA
4.12	Area and per cent of replanted forests of human origin	D	NA
4.13	Area and per cent of land on slopes on which maintenance and conservation of soil and water resources have been taken into account in silviculture according to regulations of the government	B	NA
4.14	Intensity, area and per cent of protection of forest ground vegetation	B	NA
NA	Area and per cent of forest land experiencing an accumulation of persistent toxic substances	N/A	4.h
5	Conservation of Forest Contribution to Global Carbon Cycles		5
5.1	Area of forests	A	NA
5.2	Total forest ecosystem biomass and carbon pool, and if appropriate, by forest types, age class, and successional stages	B	5.a
5.3	Area and consumption of forests for energy resources and their contribution	C	NA
5.4	Production and consumption of forest products and their contribution	C	5.c
5.5	Area of cutting and its contribution	B	NA
5.6	Absorption of carbon by forest	D	cf. 5.b

*Indicator type: A-implementation now; B-requiring some R&D; C-requiring long-term R&D; D-uncertain

Table 16. cont'd

China's Framework			Montréal Process Ref.
Ref.	Criteria and Indicators	Type*	
5.7	Carbon emission by soil	D	cf. 5.b
NA	Contribution of forest ecosystems to the total global carbon budget, including absorption and release of carbon	N/A	5.b
5.8	Release of CO ₂ and CH ₄ by peat	D	NA
6	Maintenance and Strengthening of Long-term Multiple Benefits of Forests		6
6.1	Growing and consumption, including employment	N/A	6.1+6.5
6.1.1	Population rate and economic rate	A	NA
6.1.2	Supply and consumption of wood and wood products, including consumption per capita	B	6.1.c
6.1.3	Upper limitation for annual removal of wood, and the area and location of forests available for timber production and their changes by year	B	NA
6.1.4	Supply and demand of wood and non-wood products, including their export and import	C	NA
NA	Supply and consumption or use of non-wood products	N/A	6.1.f
6.1.5	Value and volume of wood and wood or non-wood products production, including value added through downstream processing, and value of wood and non-wood products production as percentage of GDP	B	6.1.a+ 6.1.b+ 6.1.d
NA	Degree of recycling of forest products	N/A	6.1.e
6.1.6	Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment	B	6.5.a
6.1.7	Production efficiency rate, average wage rates and injury rates in major employment categories within the forest sector	B	cf.6.5.b
NA	Average wage rates and injury rates in major employment categories within the forest sector	N/A	6.5.b
NA	Viability and adaptability to changing economic conditions, of forest-dependent communities, including indigenous communities	N/A	6.5.c
NA	Area and per cent of forest land used for subsistence purposes	N/A	6.5.d
6.2	Investment in forestry	N/A	6.3
6.2.1	Value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation and tourism	B	6.3.a
6.2.2	Level of expenditure on research and development, education, and extension and use of new and improved technologies	B	6.3.b+ 6.3.c
6.2.3	Rates of return on investment	B	6.3.d

*Indicator type: A-implementation now; B-requiring some R&D; C-requiring long-term R&D; D-uncertain

Table 16. cont'd

China's Framework			Montréal Process Ref.
Ref.	Criteria and Indicators	Type*	
6.3	Forest recreation and tourism, demands and assessment of culture, social and spiritual	N/A	6.2+ 6.4
6.3.1	Value, area and per cent of forest land managed for general recreation and tourism, in relation to the total area of forest land. Number and type of facilities available for general recreation and tourism, and number of visitor days attributed to recreation and tourism, in relation to population and forest area	B	6.2.a+ 6.2.b+ 6.2.c
6.3.2	Area and per cent of forest land managed in relation to the total area of forest land to protect the range of culture, social and spiritual needs and values	B	6.4.a
NA	Non-consumptive use forest value	N/A	6.4.b
7	Legal and Policy Protection Systems		7.1-7.3
7.1	Legislation	N/A	7.1
7.1.1	Forest resource ownership	B	7.1.a
7.1.2	Institution for management of forest resources	B	7.1.b+7.1.e 7.2.b
NA	Forest management to conserve special environmental, cultural, social or scientific values, or a combination	N/A	7.1.e
7.1.3	Encouraging best practice codes for forest management	B	7.1.d
7.1.4	Adopting institution of document management in managing forest resources	B	NA
7.1.5	Strengthening administrative regulations in forest management	B	cf. 7.1.b
NA	Providing opportunities for public participation in public policy and decision-making related to forest and public access to information	N/A	7.1.c
7.2	Policy	N/A	7.2
7.2.1	Public participation in forestry	B	7.2.a+ 7.1.c
NA	Undertaking and implementing periodic forest-related planning, assessment, and policy review including cross-sectoral planning and co-ordination	N/A	7.2.b
7.2.2	Developing and maintaining human resource skills	B	7.2.c
7.2.3	Adjusting the structure of forestry industry	B	NA
7.2.4	Developing and maintaining efficient physical infrastructure	B	7.2.d
NA	Enforcing laws, regulations and guidelines	N/A	7.2.e
7.3	Economic framework	N/A	7.3
NA	Investment and taxation policies and a regulatory environment in order to meet long-term demands for forest products and services	N/A	7.3.a
7.3.1	Favourable policy on forestry investment and taxation	B	cf. 7.3.a

*Indicator type: A-implementation now; B-requiring some R&D; C-requiring long-term R&D; D-uncertain

Table 16. cont'd

China's Framework			Montréal Process
Ref.	Criteria and Indicators	Type*	Ref.
7.3.2	Adopting policy collecting silviculture expenditure	B	cf. 7.3.a
7.3.3	Establishing forest ecological compensation system	C	cf. 7.3.a
7.3.4	Strengthening institution of forest funds	B	cf. 7.3.a
7.3.5	Expanding fund channel for forestry construction	B	cf. 7.3.a
7.3.6	Absorbing and exploitation of overseas funds to speed up major project construction in forestry	B	cf. 7.3.a
7.3.7	Speeding up construction of institute for modern forestry enterprise	B	cf. 7.3.a
7.3.8	Establishing fair trading on forest products gradually	B	7.3.b
8	Information and Technological Support Systems		7.4-7.5
8.1	Measurement and monitoring	N/A	7.4
8.1.1	Availability and extent of up-to-date data, statistics and other information important to measuring or describing indicators associated with criteria 1 to 7	A	7.4.a
8.1.2	Scope, frequency and statistical reliability of forest inventories, assessments, monitoring and other relevant information	B	7.4.b
8.1.3	Compatibility with other countries in measuring, monitoring and reporting on indicators	B	7.4.c
8.2	Research and development	N/A	7.5
8.2.1	Development of scientific understanding of forest ecosystem characteristics and function	B	7.5.a
8.2.2	Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems	B	7.5.b
8.2.3	Evaluation of the contribution of science and technology	B	cf.7.5.c
8.2.4	Enhancement of ability to predict impacts of human intervention on forests	B	7.5.d
8.2.5	Ability to predict impacts on forests of possible climate change	B	7.5.e

*Indicator type: A-implementation now; B-requiring some R&D; C-requiring long-term R&D; D-uncertain

Criteria and Indicators at the Sub-national Level in China

China has developed its criteria and indicators at two sub-national levels, the regional level and the forest management unit (FMU) level. As China is a country with vast territory and a rich diversity of forest types, the sub-national criteria and indicators should be more specific to the local situations, with appropriate deletion or addition of indicators within the national framework. Indicators that are not measurable at sub-national levels should be not considered, although they are important at the national level. Furthermore, to make an effective evaluation at the national level, it is necessary to weight each indicator at the sub-national level according to the local objectives of forest management.

Since 1997, the identification and testing of regional criteria and indicators have been conducted in three representative forest zones. The Yichun in Heilongjiang Province, Fenxi in Jiangxi Province and Zhangye in Gansu Province are representatives of the Northeast State Owned Forest Zone, South Collective Owned Forest Zone, and Northwest Dry Land Forest Zone, respectively. The development and testing of criteria and indicators in these three sites were funded by the UNDP, called CPR/96/109 Project *Capacity Building, Research and Extension for Sustainable Forest Management*. A number of experts, both national and international, have been involved in this project.

The draft sets of regional criteria and indicators, each with eight criteria similar to the national level, have been developed for the three representative forest zones in China (Table 17). In total, the 60 indicators for Fenxi in the Southeast of China are mainly related to forest ownership, plantations, and cash tree plantations. The 68 indicators for Zhangye in the Northwest concentrate environmental and social issues (water resource conservation forest, shelterbelt, and cash tree plantations). The 77 indicators defined for Yichun in the Northeast focus mainly on the maintenance of forest productivity.

Table 17. Indicators at the regional (sub-national) level in three typical forest zones of China

Criterion	National level	Sub-national level		
		Fenxi, Jiangxi	Zhangye, Gansu	Yichun, Heilongjiang
C1, Biodiversity	10	11	13	9
C2, Productivity	8	9	8	12
C3, Health and vitality	3	3	8	3
C4, Soil and water	14	11	8	8
C5, Carbon cycles	8	3	4	5
C6, Multiple benefits	12	9	10	14
C7, Legal and policy	17	10	10	18
C8, Information and technology	8	4	7	8
Total	80	60	68	77

Also, the criteria and indicators have been developed and tested at the forest management unit level in the three representative sites, including selection of the indicators, a feasibility study for data collection and the process for reporting of criteria and indicators. Most of the indicators at this level are developed from criteria 1 to 4 (Table 18).

Table 18. Criteria and number of possible indicators at the forest management unit level in three representative forest zones of China

Criterion	C1	C2	C3	C4	C5	C6	C7	C8	Total
Dagangshan, Fenyi, Jiangxi	10	5	4	8	3	8	9	0	47
Xishui, Zhangye, Gansu	8	3	2	5	3	4	3	0	28
Fenlin, Yichun, Heilongjiang	8	10	1	4	1	7	7	0	38

45

Experiment and Demonstration Network for Sustainable Forestry Development in China

China's experiment and demonstration areas

In order to examine the approach to sustainable forestry development and to implement a plan based on the Forestry Action Plan for China's Agenda 21, the Chinese Government initiated the establishment of an experiment and demonstration area on sustainable forestry development. One of main objectives is to give support to China's practice and international discussion on SFM. Since 1997, eight experiment and demonstration areas on sustainable forestry development have been selected across the ecozones of China (Table 19).

Table 19. Demonstration forest network for sustainable forest management in China

Forest zone	Location	Years	Issues focused
Northeast State Forestry Zone	Yichun, Heilongjiang	1997-	Protection of natural forest
	Muling, Heilongjiang	1997-	Development of large State forest bureaux
Three-North Dryland Forestry Zone	Zhangye, Gansu	1997-	Management of water conservation forest
	Pingshan, Hebei	1997-	Sustainable mountainous area development
Collective forestry zone	Fenyi, Jiangxi	1997-	Collective-owned forest management
	Tonggu, Jiangxi	1997-	Plantation management
	Lin'an, Zhejiang	1998-	Sustainable mountainous area development
	Zhanjiang, Guangdong	1997-	Forestry and forest industry

Join in activities of the International Model Forest Network

In 1996, China's Forestry Department agreed to join in the activities of the International Model Forest Network at the invitation of Department of Natural Resources of Canada. The construction of China's Model Forest Network was documented in a memorandum on forestry co-operation between China and Canada.

China's Model Forest Network has been established on the basis of areas for National experiment and demonstration on sustainable forestry development. Linan County in Zhejiang Province was selected as the first model forest in China. An international workshop on China's model forests jointly supported by IMFNS, the Canadian Forest Service and the Chinese Academy of Forestry, was held in Linan from 29 March to 2 April 1999. The workshop dealt with how to implement the Chinese Model Forest Network, especially in the Linan Model Forest. Some pioneer activities such as potential partnership identification, farmers' training, and eco-tourism planning and implementation have been conducted.

China's Model Forest Network is participating in a series of four regional workshops, held in Tokyo, Mie Prefecture and Gunma Prefecture, on Model Forests for Field-level Application of Sustainable Forest Management. In this project, supported by Japan, Chinese experiences on SFM at the operational level and on model forest building were introduced at the workshop.

China is one of the member countries of the Japan/FAO trust funding project known as The Regional Project on Assistance for the Implementation of the Model Forest Approach for Sustainable Forest Management in the Asia-Pacific Region. The project, which has been conducted since January 2000 with China and three other countries (Thailand, Myanmar and Philippines) as members, will promote the model forest establishment in the Asia-Pacific region.

Major Constraints for Implementing Sustainable Forest Management in China

China also faces many constraints for implementing criteria and indicators. Generally speaking, the main constraints are a shortage of forest resources, serious ecological and environmental degradation, high pressure from the increasing population, and social and economic growth. In China, the mountain areas have a very low capacity for economic development, resulting in a vicious circle of poverty, resource deterioration and further poverty. This circle becomes the main constraint for national economic and social development. In addition to the condition of natural resources and the particular capacities of the economy, science and technology, implementing SFM also requires greater environmental awareness and wider understanding by the public. Weak public awareness and understanding of SFM are a great constraint. Therefore, strengthening publicity, education and training and improving the awareness of SFM by the various social classes, including foresters, are very important to promote this management approach. In the meantime, implementation of criteria and indicators for SFM requires relevant policies and regulations as an essential guarantee.

It is very difficult to develop national and unified operational criteria and indicators for SFM in a short period. China could share in the successful experiences with international society in developing and implementing such criteria and indicators. Strengthening international co-operation could promote implementation of criteria and indicators for SFM in China and other countries.

Vignette on Japan

Background

47

Through preparatory work for the First Approximation Report on the Montréal Process in 1997, it was identified that, out of the 47 indicators within Criteria 1 to 6, data were fully available for 13 indicators, partially available for 16 indicators, and not available for the remaining 18 indicators. This report led the Forestry Agency and other relevant agencies to recognise the importance of application or implementation and further development of criteria and indicators (C&I) at the national as well as the sub-national level.

To follow up the 1997 report and to make progress in application, development and implementation of C&I in Japan, the following nine initiatives have been conducted since 1997. The first three initiatives are to directly measure some C&I while the other six are relevant to C&I development. The following section summarises all these initiatives and the third section explains the three initiatives on measurement in further detail.

Initiatives Related to Criteria and Indicators

The following three initiatives aim to measure some Montréal Process C&I.

Continuous Forest Inventory Project

The Continuous Forest Inventory Project, a new, nation-wide, forest resources assessment survey, was launched in 1999. This survey uses statistical sampling inventory methodology in about 15 700 permanent survey plots. Contrary to the existing conventional survey which is primarily for preparation of forest management plans, this Project is intended to monitor and assess forest resources and their discernible trends and dynamics, focusing on forest type classification, growing stock and biomass inventory, and incorporating an ecosystem approach.

Testing Criteria and Indicators in the Kasama Study Area

The Forestry and Forest Products Research Institute (FFPRI) of the Forestry Agency started a five-year research project in 1996 at the Kasama Forest Technology Center, covering 134 000 hectares of 15 municipalities. This project aims to develop appropriate data collecting methodologies for some Montréal Process indicators, particularly those related to biological diversity, productivity, forest ecosystem health, soil and water conservation, carbon sequestration and multiple socio-economic benefits.

Research on Forest Infrastructure Design for Forest Ecosystem Approach

In 1996, the Forestry Agency started a 10 year survey project to introduce forest ecosystem-oriented infrastructure work, such as forest roads and control dams, in association with the development and application of local-level C&I. The survey covers two areas — Ishikari-Sorachi (806 000 hectares) in Hokkaido, and Shimantogawa (297 000 hectares) in Kochi — which are taken from 158 forest management planning units designated by the Forest Law.

The following six initiatives are relevant to C&I application.

Amendment of the Forest Law and Other Forestry-Related Laws

In 1998, relevant laws including the Forest Law were amended to contribute to the promotion of sustainable forest management (SFM) nation-wide. As a result, Japan introduced a system that makes it possible for anyone concerned to make comments on draft forest management plans at the local government level. In addition, as a result of this amendment, municipalities are authorised to make and to implement forest management plans except for national forests within their jurisdiction.

International Workshops on Model Forests

In 1996, the Forestry Agency committed itself to host a series of workshops on model forests to promote SFM on a global scale. Consequently, since 1998, in technical collaboration with the Food and Agriculture Organization of the United Nations and the International Model Forest Network Secretariat, the Forestry Agency has hosted a series of international workshops for the promotion of model forests as a field-level application of SFM, focusing particularly on the Asian region.

Acid Deposition Monitoring

The Environment Agency has been conducting an Acid Deposition Survey since 1983, and its Phase IV started in 1998. For wet deposition, the survey monitors (1) acid deposition to observe concentration and flux of acidic substances deposited on the land surface, and (2) soil and vegetation, and inland aquatic environments, to assess adverse impacts on terrestrial and aquatic ecosystems. As for dry deposition, the concentration of air pollutants such as SO₂, NO_x, and O₃ have been monitored on an hourly basis at the general air pollution monitoring stations and the acid deposition monitoring stations.

Forest Health Monitoring

Since 1990, the Forestry Agency has also implemented a monitoring survey for early detection of forest decline induced by acid rain and air pollution. This survey monitors soil and vegetation conditions, quality of rain, and the extent of forest decline, at about 1 200 fixed monitoring plots. One-fifth of the plots are surveyed every year and consequently, all the monitoring plots are examined in five years.

Training Course for Practical Case Studies on Sustainable Forest Management

The Japan International Co-operation Agency (JICA) will start a new 40-day training course in Japan in 2000. From then until 2009, 13 trainees will be trained annually. This course is for administrators and practitioners of national forest programs of developing countries, including Montréal Process member countries. Its curriculum covers a wide range of programs and initiatives for practical implementation of SFM, such as development and application of C&I, and model forests as field demonstrations of SFM.

Biodiversity Center of Japan

The Environment Agency established the Biodiversity Center of Japan (BiodiC-J), in April 1998. BiodiC-J plans and carries out basic surveys such as the National Survey on the Natural Environment (Green Census) on fauna, flora, and others, to examine the present status and long-term discernible change of the natural environment in Japan. Based on the results of the Green Census and other information, BiodiC-J provides the database on natural environment and biological diversity, which is to be shared widely through the Internet.

49

Initiatives Related to Measuring

Continuous Forest Inventory Project

A new survey was launched in 1999 to introduce a C&I-based statistical sampling methodology into a nation-wide forest resources assessment. The current conventional survey has been used primarily to prepare forest management plans, and its statistical accuracy cannot be verifiable. Furthermore, the data related to biological diversity measured by this conventional survey are insufficient. Nonetheless, the standard site method has provided yield projection tables for commercial species and sites.

Therefore, in the Continuous Forest Inventory Project, the following statistical sampling methodology is introduced. Drawing grids 4 kilometres by 4 kilometres all over Japan, we established about 15 700 permanent plots, where two grid lines cross each other, covering all the forest area (25 150 000 hectares in total). A permanent survey plot is a circle with a radius of about 18 metres or an area of 0.1 hectare, placing the crossing point as a center of the plot. The survey will be conducted on one-fifth of all the plots, or about 3 000 plots, every year. In sum, all the plots will be surveyed in five years; each survey plot will be examined once every five years.

The main objective of the survey is to monitor and assess relatively long-term discernible trends and dynamics in the state of forests in Japan, under the nationally unified methodology. At the same time, it is designed to be compatible with some of the Montréal Process C&I. The indicators covered under this survey are as follows:

Criterion 1: *Conservation of biological diversity*

1.1 *Ecosystem diversity*

- 1.1.a Extent of area by forest type relative to total forest area
- 1.1.b Extent of area by forest type and by age class or successional stage
- 1.1.c Extent of area by forest type in protected area categories as defined by IUCN or other classification systems
- 1.1.d Extent of areas by forest type in protected areas defined by age class or successional stage

Criterion 2: *Maintenance of productive capacity of forest ecosystems*

- 2.a Area of forest land and net area of forest land available for timber production
- 2.b Total growing stock of both merchantable and non-merchantable tree species on forest land available for timber production
- 2.c Area and growing stock of plantations of native and exotic species
- 2.d Annual removal of wood products compared to the volume determined to be sustainable

Criterion 3: *Maintenance of forest ecosystem health and vitality*

- 3.a Area and percentage of forest affected by processes or agents beyond the range of historic variation, for example, by insects, disease, competition from exotic species, fire, storm, land clearance, permanent flooding, salinisation, and domestic animals

Criterion 4: *Conservation and maintenance of soil and water resources*

- 4.a Area and percentage of forest land with significant soil erosion

Criterion 5: *Maintenance of forest contribution to global carbon cycles*

- 5.a Total forest ecosystem biomass and carbon pool, and if appropriate, by forest type, age class, and successional stages
- 5.b Contribution of forest ecosystems to the total global carbon budget, including absorption and release of carbon (standing biomass, coarse woody debris, peat and soil carbon)

Testing Criteria and Indicators in the Kasama Study Area

A testing project has been conducted since 1996 in Kasama Study Area, located in east-central Japan. The total land area of the Kasama Study Area is 134 000 hectares, which includes 15 local municipalities and 53 000 hectares of forests. The project attempts to establish a prototype methodology for the application of C&I, at both the national and the local levels. At the national level, the project explores the possibility and accountability of using the existing statistical data as sources for some indicators, and also proposes technically and financially feasible methodologies for other indicators for which no statistical data are available. At the local level, while using the existing statistical data, the project compares and analyses chronological trends of some indicators among municipalities and forest management planning units in order to assess relatively long-term discernible trends and dynamics in the state of forests.

Moreover, it is important to elaborate this permanent plot survey to comprehend other additional indicators and at the same time, to develop additional methodologies to measure indicators that cannot be used with this permanent plot survey, or are difficult to measure.

The following indicators are placed under the analysis of this project:

Criterion 1: Conservation of biological diversity

- Ecosystem diversity and its fragmentation from vegetation maps
- Number of species of wood decay fungi found in each forest type
- Stand age of Hinoki-cypress (*Chamaecyparis obtusa*) plantations and species richness in forest floor vegetation
- Number of forest-dependent endangered birds and butterflies
- Genetic diversity of beech (*Fagus crenata*) based on Simple Sequence Repeat (SSR) markers

Criterion 2: Maintenance of productive capacity of forest ecosystems

- Growing stock in each prefecture

Criterion 3: Maintenance of forest ecosystem health and vitality

- Pine wilt disease caused by invading wood nematode pathogen (*Bursaphelenchus xylophilus*)
- Forest health monitoring (Monitoring of forest decline caused by acid rain and air pollution)

Criterion 4: *Conservation and maintenance of soil and water resources*

- Area of forest land managed primarily for protection function
- Difference of water quality between watersheds

Criterion 5: *Maintenance of forest contribution to global carbon cycles*

- Relationship between stand volume and total biomass
- Annual uptake of carbon dioxide by Japanese forests
- Relation of soil depth and carbon storage at each soil type

Criterion 6: *Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of society*

- Ratio of gross forestry product to gross domestic product
- Potential resources and facilities for forest recreation and tourism in the Kasama Study Area

Criterion 7: *Legal, institutional and economic framework for forest conservation and sustainable management*

- Developing a diagram showing relationship between forest planning system and indicators of Criterion 7

Research on Forest Infrastructure Design for Sustainable Forest Ecosystem

The Forestry Agency recognises the need to introduce forest ecosystem-oriented infrastructure work such as forest roads and control dams in association with the development and application of local-level C&I to achieve SFM. From this point of view, since 1996 a 10-year study project has been carried out by two local governments (Hokkaido and Kochi Prefectures) in co-operation with the Forest and Forest Products Research Institute (FFPRI), the Prefecture Forestry Research Institutes and the Regional Forest Offices.

In two study areas, the Ishikari-Sorachi forest management planning unit in Hokkaido prefecture and the Shimantogawa forest management planning unit in Kochi prefecture, primary activities are concentrating on the development and application of local-level indicators for monitoring trends of the functions that forests would provide. Through the study, it is expected that a group or groups of indicators that represent discernible trends of specific functions affected by any infrastructure work in forests will be identified.

Based on the results of this study, some guidelines for designing forest infrastructure work in forests paying due consideration to the forest ecosystem approach will be developed in the various forest management planning units.

Moreover, this project will be classified as a domestic model-forest initiative.

Ishikari-Sorachi Project

Hokkaido Prefecture has been implementing the Ishikari-Sorachi Project in co-operation with the Hokkaido Prefecture Forestry Research Institute, the Hokkaido Research Center of FFPRI and the Hokkaido Regional Forest Office. In this area, there are 30 municipalities with 508 000 hectares of forest within a total area of 806 000 hectares. Most of the forests are natural with national or local government ownership. The following is a list of indicators measured in this study area.

Criterion 1: Conservation of biological diversity

- Inventories of fish, forest-dependent birds and field mice

Criterion 2: Maintenance of productive capacity of forest ecosystems

- Developing forest management systems with a geographic information system (GIS)
- Monitoring of growth of natural forests

Criterion 3: Maintenance of forest ecosystem health and vitality

- Monitoring of acid rain situation

Criterion 4: Conservation and maintenance of soil and water resources

- Research to measure effect of logging on water quality

Criterion 5: Maintenance of forest contribution to global carbon cycles

- Assessment of carbon flow in mountain streams

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of society

- Monitoring of recreational use of forests

Shimantogawa Project

Kochi prefecture has been implementing the Shimantogawa Model Forest Project in co-operation with the Kochi Prefecture Forestry Research Institute, the Shikoku Research Center of FFPRI and the Shikoku Regional Forest Office. In this area there are 17 municipalities with 254 000 hectares of forest within a total area of 297 000 hectares. The following is a list of indicators measured in this study area:

Criterion 1: Conservation of biological diversity

- Extent of area by forest type and by age class
- Change in natural forest area in each municipality
- Inventories of forest-dependent species (insects, plants, etc.)

Criterion 2: Maintenance of productive capacity of forest ecosystems

- Extent of area by production forest
- Monitoring of forest stock growth

Criterion 3: Maintenance of forest ecosystem health and vitality

- Monitoring of air pollutants in rainfall
- Research on seed dispersion
- Assessment of criterion 3, using GIS layered data

Criterion 4: Conservation and maintenance of soil and water resources

- Monitoring flow and quality of mountain streams
- Research on physical and chemical properties of soil
- Assessment of criterion 4, using GIS layered data

Criterion 5: Maintenance of forest contribution to global carbon cycles

- Assessment of criterion 5, using GIS layered data

Statistics

Tables 20 to 24 present basic data on Japan's forest resource, age classes, species planted, log production and forest workers.

55

Table 20. Forest resources in Japan in 1995

(Area: 1 000 ha , Growing stock: 10 000 m³)

Area: 1 000 ha , Growing stock: 10 000 m³)

Ownership classification		Total		Forest land				Others	
				Planted forest		Natural forest			
		Area	Stock	Area	Stock	Area	Stock	Area	Stock
Grand total		25 146	348 323	10 398	189 199	13 382	159 002	1 366	123
National forest	Total	7 844	91 207	2 446	29 223	4 738	61 871	660	112
	Forestry Agency	7 647	89 246	2 417	28 925	4 608	60 208	622	112
	Others	197	1 961	29	298	130	1 663	38	0
Private and public forest	Total	17 302	257 117	7 952	159 976	8 644	97 131	706	10
	Public	2 730	35 906	1 209	19 859	1 433	16 042	88	6
	Private	14 572	221 210	6 743	140 117	7 211	81 089	618	4

Source: Forestry Agency working paper

Notes:

- Forests are as defined in the Forest Law, article 2, item 1. They include forests not covered by Regional Forest Plans.
- Non-forest land is either recent logged-over land or non-stocked land.
- Natural forest includes lands where regeneration is extremely difficult.
- Due to rounding of figures, totals may not coincide.

Table 21. Area of planted forests by age class in 1995

Age Class	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45
Area (1 000ha)	278	421	699	937	1 336	1 686	1 719	1 388	735
Age Class	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81+	Total
Area (1 000ha)	262	213	172	139	112	86	67	105	10 355

Source : Forestry Agency internal working paper

Note : Area covered by Regional Forest Plans

Table 22. Main planted species in planted forests in 1995

Species	Coniferous trees					Total	Broad-leaved trees	Grand Total
	Sugi (<i>Cryptomeria japonica</i>)	Hinoki (<i>Chamaecyparis obtusa</i>)	Pines (<i>Pinus</i> spp.)	Larch (<i>Larix kaempferi</i>)	Others			
Area (1 000 ha)	4 536	2 529	981	1 071	1 008	10 125	230	10 355

Source : Forestry Agency internal working paper

Note: Area covered by Regional Forest Plans

Table 23. Recent trends in log production

(1 000 m³)

	Year				
	1992	1993	1994	1995	1996
Grand Total	27 114	25 570	24 456	22 897	22 469
Ownership					
Private forest	18 507 (68)	17 759 (69)	17 484 (71)	16 542 (72)	16 600 (74)
Public forest	1 324 (5)	1 511 (6)	1 420 (6)	1 235 (5)	1 256 (6)
National forest	7 283 (27)	6 300 (25)	5 552 (23)	5 120 (22)	4 613 (21)
Species softwood	18 900 (70)	18 770 (73)	19 090 (78)	18 067 (79)	17 993 (80)
Sugi (<i>Cryptomeria japonica</i>)	8 819	8 995	9 451	8 948	9 078
Hinoki (<i>Chamaecyparis obtusa</i>)	3 074	3 051	3 125	2 924	2 907
Red/Black pines (<i>Pinus densiflora</i> / <i>Pinus thunbergii</i>)	2 446	2 255	2 119	2 036	1 918
Larch, Todomatu, Ezomatu (<i>Larix kaempferi</i> / <i>Abies sachalinensis</i> / <i>Picea jezoensis</i>)	3 820	3 737	3 707	3 575	3 546
Fir, Tuga (<i>Abies firma</i> / <i>Tsuga sieboldii</i>)	182	168	146	141	126
Others	559	566	542	443	418
Hard wood	8 214 (30)	6 798 (27)	5 366 (22)	4 830 (21)	4 476 (20)
Oak (<i>Quercus serrata</i> , etc.)	496	423	338	292	285
Beech (<i>Fagus crenata</i> , etc.)	433	390	326	281	249
Others	7 285	5 985	4 702	4 257	3 942
Use					
Sawlogs	17 240 (64)	17 293 (68)	17 440 (71)	16 252 (71)	16 154 (72)
Pulp	1 240 (5)	1 130 (4)	1 188 (5)	1 209 (5)	1 100 (5)
Plywood	277 (1)	274 (1)	253 (1)	228 (1)	228 (1)
Wood chips	7 810 (29)	6 367 (25)	5 094 (21)	4 762 (21)	4 558 (20)
Others	547 (2)	506 (2)	481 (2)	446 (2)	429 (2)

Source : Ministry of Agriculture, Forestry and Fisheries , "Report on Supply and Demand of Wood"

Notes:

- The figures in parentheses are percentages against the total
- National forest includes forests administered by the Forest Development Corporation and governmental forests administered other than the Forestry Agency.
- Other uses of wood include electric poles, stakes, scaffoldings, etc.
- The production volume does not include logging residues

Table 24. Number of forest workers by age class

(100 persons)

Age class	Year		
	1985	1990	1995
15-24	38	21	25
25-29	40	33	24
30-39	146	93	75
40-49	343	198	141
50-59	586	468	283
60+	246	262	309
Total	1 400	1 100	900

Source: General Administration Agency, "National Census"

Vignette on Korea

Introduction

Korea is a mountainous country, covered largely by forest, which accounts for 65 per cent of the total land area of 9.9 million hectares. The forest in Korea has, therefore, deeply influenced Korean people in their attitudes toward the natural environment and their daily lives. Mountains with dense forests and various animals and vegetation have been a cornerstone in forming a deep respect for nature.

Through the long history of Korea, wise management of forests and water flows has been the most important among governmental priorities. However, severe deforestation occurred early in the 1900s due to social turbulence. Through long-term Forest Plans, Korea has been successful in the past several decades in again greening the country. The fourth National Forest Plan, which started in 1998, embodied the foundations of sustainable forest management (SFM) and established targets, strategies and major programmes.

The pressures on forest land for other purposes such as urban, residential and recreational uses are ever increasing. Recent demands for environmental benefits from the forests have increased from society, and systematic and intensive SFM techniques including plantations, silvicultural practices and efficient management structures are required to meet the various demands, to maintain the ecological health of forest resources and to improve forest productivity.

On the other hand, the economic crisis in Korea, starting in 1997, brought unexpected opportunities to the forest sector, as the unemployed became more willing to accept difficult forest work. In 1998, the Forest for Life Project ("Soop Kakoogi" in Korean), which will continue to 2002, was launched to hire the unemployed for silvicultural work including weeding, pruning, thinning and understorey cutting. As a result, the perception and awareness of the general public toward the importance of SFM have been greatly enhanced. In addition, the nation-wide concern about forest tending methodology had positive side effects in improving related forest technologies.

Conservation of Biological Diversity

Forest types in Korea, which total 6 441 304 hectares, have been classified into five categories — conifer, broad-leaved, mixed forests, bamboo stands and non-stocked area. Conifer forest occupies about 43 per cent of the forest land; broad-leaved and mixed forests each account for about 26 per cent. There are still non-stocked areas because of topographical features. Average stock volume per hectare for each type of forest does not differ greatly and averages about 55 cubic metres per hectare.

There are many categories of protected areas in Korea. The largest protected category includes Natural Environment Conservation Areas, which cover about 870 000 hectares designated under the National Land Use Control Law. In all, 20 national, 20 provincial and 26 county parks have been established to protect landscapes and other land use under the Natural Parks Law of 1980. Under the Forest Law, Natural Forest Reserves have been designated in 133 sites, covering 11 100 hectares, to conserve natural ecosystems.

Although Korea's forests mostly are in the temperate zone, the total number of forest-dependent species, including flora and fauna, is known to be up to 5 074. Among the 1 049 species of woody plants, there are 51 conifers and 998 broad-leaved species. There are about 3 545 herbaceous species, of which 271 are annuals and 3 274 are perennials.

The forest-dependent species determined as species at risk are classified into four categories — endangered, vulnerable, endemic and rare. About 180 species are considered to be at risk of not being sustained in the long term. There are 126 plant species determined to be at risk; 16 are endangered, 20 are vulnerable, 41 are endemic and 49 are rare.

The forest tending project ("Soop Kakoogi"), which involves hiring the unemployed, was launched primarily for timber production. However, environmental organisations and public opinion leaders protested against the initial purpose and proposed that conservation of biodiversity and multiple objectives of forests be considered in the project through protection of understorey vegetation. Consequently, the productivity of forest ecosystems and biological diversity increased considerably and the perception and awareness of the general public about the importance of SFM were greatly enhanced.

Maintenance of Productive Capacity of Forest Ecosystems

Until recently, the forests in Korea were classified into two categories, reserve and non-reserve forests, occupying 75 per cent and 25 per cent, respectively, of all forest lands. Through amendment of the Forest Law in 1994, forest land has been classified into three categories, production, public service and semi-conservation, to reflect the changing socio-economic conditions and meet the various demands for forest products and services of the general public in a more efficient way.

In 1995, the Forestry Administration changed the forest land classification system by revising the legislation, which was focused on the uses of forests. Now production forest accounts for 3.6 million hectares, about 57 per cent of the total forest land base.

Forest policy and planning have emphasised the enlargement of commercial forests and have thus tried to raise the self-sufficiency ratio of forest products. According to long-term estimates, commercial forest lands will occupy about 44 per cent of all forest land, totalling up to 2.9 million hectares by 2007, and up to 55 per cent of all forests and totalling up to 3.5 million hectares by 2050.

Although reforestation has been successfully accomplished, harvestable forest resources are extremely limited because about 84 per cent of the forests are less than 30 years old and have little economic value. In past years, demand for timber has sharply increased as a result of national economic development, and about 90 per cent of the timber demand is dependent on foreign sources. To increase productivity, a variety of mechanical equipment adaptable to the mountainous forests needs to be developed.

To manage forests sustainably, the forest road network should be expanded to 10 metres per hectare by the end of 2010, from 2.1 metres per hectare in 1998. This will provide for better accessibility of mechanical equipment and lower overall costs for forest management. Forest roads will be concentrated in the production forests for mechanised silvicultural works and will be subject to advanced and environmentally sound construction techniques, which will minimise damage to the forest environment. Regional mechanical equipment centers will be established to provide rental units for forest owners and forest products producers.

Maintenance of Forest Ecosystem Health and Vitality

Forest ecosystem health and vitality have been among the forest management priorities. Through the success of reforestation, most forests are young and forest protection has been strictly enforced across the country. Many administrative branches have been involved in forest protection, in particular fire protection.

The extent of forest areas affected by processes or agents beyond the range of historic variation can be assessed only for insects, diseases and fire. Information concerning the extent of forest areas affected by air pollution and diminished biological components is difficult to collect. Only recently have survey plots been designated across the country to periodically collect data on the level of various air pollutants in forests. In particular, data on ultraviolet and biological components indicative of ecological continuity are of doubtful value for collection at the national level.

Forest fires cause the most serious damage to forest resources and ecosystems during spring and autumn. In Korea, about 84 per cent of the forests are less than 30 years of age and, as trees grow older, ground litter and woody debris accumulate on the forest floor. Forests are also at great risk from human-caused, careless fire, as a result of the increased numbers of people visiting the forests for recreational activities. In the case of forest fires, the Korean Forestry Administration and local governments, including cities and provinces, have established and maintain ground and airborne fire-fighting squads and supporting teams. These units were founded, as a result of a review of the forest fire outbreak in the Kosung area in April 1996, and immediately dispatch members to fires by helicopters and ground vehicles to effectively suppress forest fires. In 1998, a total of 265 forest fires, about half of them caused by carelessness, broke out and destroyed more than 1 014 hectares nation-wide.

Conservation and Maintenance of Soil and Water Resources

As large portions of Korea are mountainous and as precipitation is usually concentrated during the summer season, landslides and soil erosion have been common across the country. During the past several decades, political and social turbulence resulted in serious deforestation and forest resource degradation nation-wide. The forest policy has focused on prevention of soil erosion, rehabilitation and reforestation in vulnerable areas. Owing to successful reforestation and active soil erosion control projects accomplished by the Korean government and the general public, the occurrence of landslides and soil erosion has been greatly reduced since the 1980s.

This criterion also includes various aspects of soil and water properties related to protective functions provided by forests. Since the 1950s, relatively accurate data on soil erosion have been collected, because large soil erosion control projects require accurate data and analysis. Since 1961, various protective forests have been designated and continue to increase in size in response to the ever-increasing social demand for various environmental needs. It is very difficult to obtain data on the other indicators of this criterion. These indicators are mainly related to various chemical and physical properties that would require the collection and analysis of related data at the national level, with substantial research and scientific technology required.

Maintenance of the Forest Contribution to Global Carbon Cycles

The total growing stock volume of Korean forests is about 340 million cubic metres, and the annual growth rate since 1990 is estimated at about 2 cubic metres per hectare. The amount of carbon storage in forests can be estimated through the results of studies on the volume of growing stock harvested, readily found in the statistical yearbook of the Korean Forestry Administration. The Intergovernmental Panel on Climate Change (IPCC) has identified the four major factors influencing the absorption and emission of carbon dioxide as forest conversion, grassland conversion, forest regrowth and silvicultural practices. In Korea, it is illegal to burn log and other debris that result from forest conversion to other land uses. When conversion occurs, emission of carbon is generally inevitable, but studies on the carbon storage in forest soils have not been carried out widely or in depth.

In many rural communities the extent of uncultivated agricultural lands has increased because of the shortage of labour forces. Forest regrowth on these uncultivated croplands has had a positive impact on carbon absorption and storage. It is feasible that these uncultivated lands could be rehabilitated into forests in the future. Additionally, normal silvicultural practices influence the amount of carbon absorption and emission through stock volume increase and timber harvesting.

Maintenance and Enhancement of Long-term Multiple Socio-economic Benefits to Meet the Needs of Societies

In the category of production and consumption, data for almost all indicators is readily available in the Statistical Yearbook of Forests issued annually. However, data on value added to forest products through downstream processing are not easily available, and some research would be necessary to enhance the reliability and to widen the scope to include non-timber forest products, including edible and medicinal plants collected from forests.

63

The technology for timber quality enhancement including antiseptic treatment techniques will be improved for high-quality forest products. Research and development projects in the field of forest products utilisation will be strengthened and more investments will be made to develop new materials, to broaden the scope of utilisation, including thinned small-sized timber, and to identify highly value-added forest products. A comprehensive forest products distribution center has been established in Yaju and centers will be established in other locations for more effective collection, storage, processing and sales of forest products.

Data on recreation and tourism is available because there are certain types of forests that have been designated primarily for these purposes. These forests include natural parks and recreational forests. Other areas are used for youth camps and for environmental education and are under the control of various authorities and require further studies. Only a portion of the data concerning park visitors can be estimated and only in a few case studies.

Legal, Institutional and Economic Framework for Forest Conservation and Sustainable Management

In accordance with the Forest Law, enacted in 1961 and amended in 1964 to reflect recently emerging challenges and opportunities in forest resource management, the Fourth 10-year Forest Plan was begun in 1998. The plan will provide the basic framework of forest policies and objectives and provide overall management directions on the conservation and sustainable development of forest resources. In Korea, the modern forest management scheme emerged with the formulation of the fundamental Forest Law and the Erosion Control Law of 1962. Intensive forest restoration and nation-wide planting projects began on the basis of the First 10-year Forest Development Plan that began in 1973. Through the successful implementation of the Second and Third Forest Plans, reforestation has been accomplished across the country. The Fourth 10-year Plan will place emphasis on laying the framework for intensive and SFM to maintain healthy and vital forest ecosystems and to produce forest products in a sustainable manner. The ultimate goal is to provide the foundation for SFM through the accomplishment of major programs based on major strategies. To accomplish the policy goals, more valuable forest resources will be established, competitive forest industries will be fostered and a healthy and enjoyable forest environment will be maintained.

To provide for more valuable economic and environmental resources, various plantation methods will be introduced and adapted. Plantations of timber species will be enlarged, large trees will be grown in environmental forests surrounding human settlements, and fruit-bearing trees will be planted to raise incomes. The silvicultural practices will be intensively applied to produce high-quality timber through consistent thinning of conifer forests, silvicultural works in broad-leaved forests, and timely tending including understorey removal and pruning.

Forest policy will emphasise the enlargement of national forest units, because current small sizes and mixed ownerships have posed great difficulty in intensive and efficient silvicultural practice.

64 To pursue SFM, 762 project areas are employing unemployed workers in forestry operations. In 1998, a total of 2.8 million people were involved. In 1999 there will be 864 areas and 4.8 million people involved. The projects are primarily for forest tending and SFM, and will involve 70 000 hectares of forest. Some 50 000 cubic metres of branches and debris will be collected for producing sawdust that will be used for a kind of forage. The projects will produce up to 1 454 forest technicians through vocational training for forest tending. The projects have a significant impact in reducing unemployment and in enhancing awareness, understanding and participation among the general public through co-operation with civil movement organisations.

To support the forest-tending programme more efficiently and to enlarge the projects, the local branches of the Korean Forestry Administration were temporarily reorganised. Special teams ("Soop Kakoogi" Team) were established for forest tending and SFM. For each forest management unit, a preliminary study report was prepared and reviewed. The reports included the purpose of the silvicultural practices, an understanding of the tasks, and the expected future effects. In urban areas, a specific silvicultural manual was prepared giving consideration to aesthetic and ecological aspects.

Conclusion

The major objective of SFM has been to harmonise the balance between conservation for environmental benefits and economic utilisation of the forest resources. The economic utilisation of forests has traditionally come from timber and other forest products, which were largely dependent on commercial species. Plantation forests will be sustainably managed to increase the economic and environmental values.

The forest-tending project involving the hiring of the unemployed will be the second project, following the successful plantation project, to enhance the concern of the public interest and the productivity of forest ecosystems. This project, which harmonises conservation and forest ecosystem development, will eventually contribute to SFM and has enhanced the perception and awareness of the general public toward the importance of SFM. In addition, the project has had positive side effects in improving related forest technologies.

The application and implementation of SFM should be supported by research on forest ecosystems and forest technologies. The research will focus on forest productivity improvement and practical technology applicable on field sites. Research has been carried out to identify new income sources and to solve technical problems in rural communities. The results and experiences have been distributed as extension services. In particular, research on biotechnology has focused on the development of new materials for medicinal and other uses. In this context, systems for incentives and for intellectual property will be developed. Additionally, information and experience sharing with other institutes and organisations will be encouraged in the forestry sector.

Vignette on Mexico

Mexico is currently undertaking several actions to implement the Montréal Process. These include the following:

- Establishing an internal Technical Advisory Committee (TAC) to adapt the Montréal Process criteria and indicators (C&I) to national conditions and to review the available data sets to improve the C&I reports
- Including information concerning the Montréal Process in the SEMARNAP'S Internet page: <http://www.semarnap.gob.mx>
- Informing 32 Sub-delegates of Natural Resources (one per state) about the Montréal Process and the responsibilities of the country as a member of the Montréal Process
- Including the collection of as much data as possible related to the Montréal Process in planning for the Forest National Inventory 2000.

Mexico is undertaking a number of actions to promote sustainable forest management (SFM). These include the following:

- Modifying the Forest Law to improve regulations related to management plans, sustainability principles, forest products transport and regionalisation of technical advisory providers
- Creating two national programs to provide direct subsidies to promote natural forest sustainable management and commercial forest plantations
- Modifying the National Reforestation Program (PRONARE) to include seedling protection after planting of native species and to restore forest fire damaged areas.

Vignette on New Zealand

Introduction

In New Zealand (NZ), developments on sustainable forest management (SFM) are closely related to the relatively unusual characteristics of the forest sector. These features mean that, in developing SFM practices, NZ does not face some of the issues that a number of other countries are confronted with. Notably, in NZ a clear distinction exists between planted and natural forest estates, and between state and private forest ownership. Assessments of progress and innovation in NZ need to reflect this distinction.

Makeup of the NZ Forest Estate

Forests comprise 30 per cent of the NZ land area. The natural forest (6 200 000 hectares) comprises 24 per cent of the total land area (Figure 4), and the remainder is planted forest. Around 80 per cent of the natural forest is contained within the nation's Conservation Estate, from which there is no timber harvesting. A further 20 per cent is in private ownership, about half of which is Maori tribal land.

Forest expansion is almost exclusively taking place on pastoral land. The planted production estate has trebled in size over the past 30 years but still occupies only 6 per cent (1 700 000 hectares) of the total land area (Figure 4). This area, however, yields 99 per cent of roundwood removals (Figure 5) and this has helped to remove the pressure on the natural estate.

Figure 4. New Zealand Land Area Utilisation

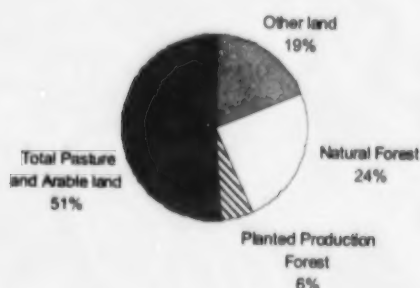
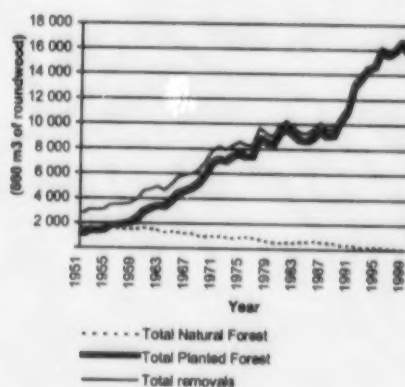


Figure 5. Estimated roundwood removals from NZ forests



NZ's emphasis is on ensuring the long-term sustainability of these forest ecosystems. Maintaining or enhancing the net area of the natural estate, for example, is a clearly specified government strategic goal for 2010.

The ability to meet this goal, however, is dependent on the significantly increased volume of wood from planted production forests that has replaced natural forest wood and is meeting the demand from both domestic and export markets.

67

Forest Management Controls

The bulk of the State-owned and planted forests were sold in the decade between 1987 and 1997. Planted forests are now almost entirely privately owned. Management of planted forests is subject to a range of land-use controls, including the Resource Management Act, that allow the owners to make commercial decisions as they see fit so long as there are not undue adverse social or ecological effects.

Since 1993, all timber extraction from naturally grown forests on private land is regulated under the sustainable management provisions of the Forests Act, administered by the Ministry of Agriculture and Forestry, apart from two exceptions. These exceptions are forests that have been transferred to indigenous people, in recognition of historical land grievances, as well as some forest being managed under transitional arrangements prior to application of the SFM provisions by the end of 2000. With respect to the indigenous settlement land, the government has recently introduced legislation that is intended to bring this land under Forest Act sustainability criteria through a negotiated settlement process.

Sustainable forest management is defined in the Act as *"management of an area of indigenous forest land in a way that maintains the ability of the forest growing on that land to continue to provide a full range of products, and amenities, in perpetuity while retaining the forests' natural values."*

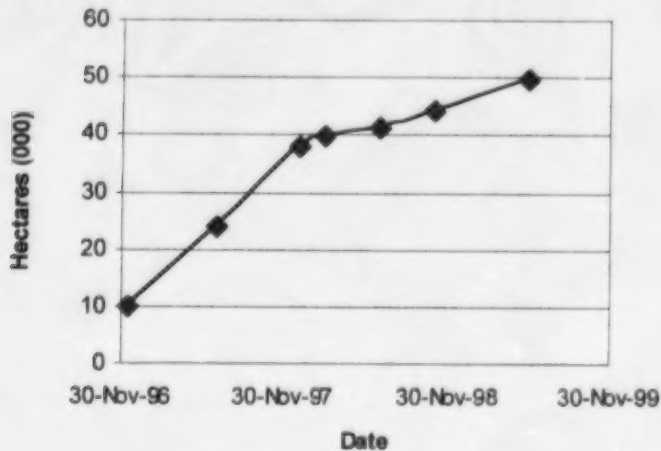
Resultant Trends in the NZ Forest Estate

Maintenance of Productive Capacity of Forest Ecosystems

Volumes harvested from natural forests have diminished over the past 50 years, from almost 100 per cent of the total NZ harvest, to currently less than 1 per cent of the total harvest. Over the same period, extraction, in absolute volume, has fallen from around 1.5 million cubic metres per year to about 125 000 cubic metres per annum. This compares with a total harvest from all NZ forests (natural and planted) in excess of 16 000 000 cubic metres per annum, of which 99 per cent is from planted forests (Figure 5).

While the level of timber production from the natural forest estate has consistently dropped over time, the area covered by government-approved SFM permits and plans has increased every year since amendments to the Forests Act in 1993 (Figure 6). In the future it is expected that the harvested volume of indigenous timber will increase slightly as more private forest land is managed under an approved plan or permit, and the increasing value of indigenous timber allows for higher-cost, lower-impact, limited extraction of timber.

Figure 6. Area covered by approved SFM Permits and Plans



Developments Relating to Criteria and Indicators

Forestry Statistics

A wide range of statistical information on the planted forest estate is now captured by the Ministry of Agriculture and Forestry, through a variety of programs, including the National Exotic Forestry Description (NFED) database and collation of information from surveys of log prices, nursery plantings, imports and exports, and wood production.

National Environmental Indicators Programme

The Ministry for the Environment is developing a national environmental indicator programme in order to provide standardised methods and protocols for the collection of environmental data. This activity is NZ's principal mechanism for developing environmental performance indicators (EPI).

The government's objectives for the EPI programme are as follows:

- To systematically measure the performance of its environmental policies and legislation
- To better prioritise policy and improve decision making
- To systematically report on the state of NZ's environmental assets.

A modified Pressure-State-Response (PSR) model has been used as the framework for indicator development. This model has been applied in many other countries and is recognised internationally as a useful framework. This approach differs somewhat from the Montréal Process criteria and indicators in that it extends beyond SFM into a broader, nationally comprehensive assessment of environmental sustainability. A staged approach to development of indicators has been undertaken, with the initial priority being given to development of indicators for the following "strands":

- Land (including forests)
- Air
- Freshwater
- Ozone
- Climate change

In future, indicators will be developed for the following topics or "strands":

- Marine environment
- Terrestrial and freshwater biodiversity
- Transport
- Energy
- Toxic contaminant
- Pests, weeds and diseases
- Urban amenity and landscape values
- Waste (including hazardous substances and contaminated sites).

The indicators will be gradually brought into use by phasing the introduction of both the strands and the specific indicators.

The relevance of the EPI programme to the Montréal Process reporting is demonstrated by considering the suite of indicators being developed for the land strand (Table 25).

Table 25. Confirmed Land Indicators

Stage 1—Ready to implement	Stage 2—Further development required
<ul style="list-style-type: none"> • Changes in areas susceptible to hill country erosion • Percentage change in area of slip at selected sites 	<ul style="list-style-type: none"> • Change in area susceptible to high country degradation • Acidity or alkalinity of soil • Organic matter • Change in area susceptible to agriculture • Change in area susceptible to reduction in soil health • Bulk density of soil • pH soil test • Organic carbon

Once the stage 1 indicators have been developed, NZ's ability to report on hill country erosion in forest ecosystems will be greatly improved. When the stage 2 indicators are implemented, NZ will be able to report more effectively against many of the indicators under Montréal Criterion 4.

Although many of the proposed indicators are not precisely aligned with the Montréal Process criteria and indicators, the substantial increase in data availability will increase the effectiveness of implementation and international SFM reporting.

Biological Diversity

Measuring biodiversity in the planted forest estate that has been deliberately established with forest stands on pastoral land may not yield much useful data.

The Department of Conservation looks after about one-third of NZ's land area protected for scenic, scientific, recreational, historic or cultural reasons. This includes national parks, forest parks, reserves and river margins. Research as well as pest, weed and predator control, ecosystem restoration, and mainland island management are undertaken. The Department also works in partnership with associates and communities for conservation on private land.

A New Zealand Draft Biodiversity Strategy was launched in January 1999 and sets a vision, goals and actions toward conserving and sustainably using NZ's biodiversity.

The intention of the draft biodiversity strategy is as follows:

- Increase knowledge of indigenous biodiversity and key threats to it. Fill critical information gaps through a co-ordinated national research strategy for biodiversity
- Make information about indigenous biodiversity more available and accessible to people and communities to enable them to make decisions and take actions to conserve and sustainably manage biodiversity
- Develop performance standards and codes of practice to assist primary producers and businesses to sustain biodiversity.

Ecosystem Diversity and Landcover Database Development

The Ministry of Agriculture and Forestry is currently completing the mapping of NZ's land cover through analysis of satellite imagery and on-ground verification (Figure 7). This database will enable the identification of 14 land cover classes to the hectare level. It is expected that these data will be pivotal in determining habitat fragmentation and quantifying the areas of remaining forest vegetation by forest type, consistent with Montréal Criterion 1. It is expected that the entire country will have been mapped prior to the year 2000.

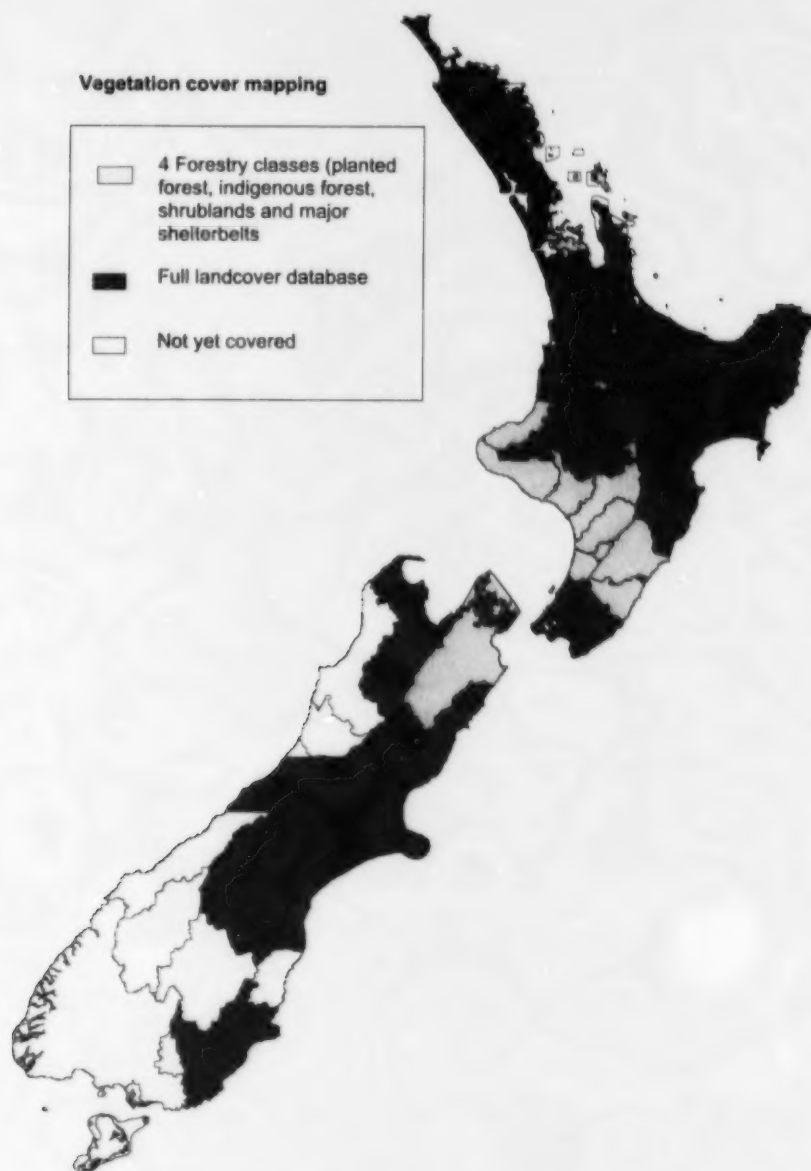
Maintenance of Forest Contribution to Global Carbon Cycles

Montréal Process Criterion 5 fits with the responsibilities of signatories to the Framework Convention on Climate Change (FCCC), which includes NZ. An assessment of NZ's ability to report to the FCCC indicated there was reasonably accurate information available on the carbon status of our emissions and on plantation forests. However, there was significant uncertainty over the carbon status of our natural forests, scrub and soils.

As noted above, NZ is currently completing mapping of its total forest area. The prime purpose of this is to be able to measure movements over time in total carbon stock.

In addition, in 1996, a three-year government funded programme was initiated with the objective of developing a framework to enable NZ to report at approximately five-yearly intervals, with known precision, on the carbon status of the natural forests, scrub and soils. This involves developing methodologies for estimating carbon from indigenous forest and for calculating soil carbon under indigenous forests. The methodologies are currently being tested across a transect of the South Island of NZ. The programme is in the third year of development, with initial implementation targeted for 2000.

Figure 7. New Zealand land cover database coverage



The need for a legal and institutional framework to support SFM and, as importantly, the political will to enforce the framework are critical for SFM. Recent developments in NZ's legislation, and associated country and industry agreements that serve as indicators of the development of and commitment to SFM, consistent with Montréal Process Criterion 7, include the following:

- The Resource Management Act 1991
- Sustainable Forest Management amendments to the Forests Act — 1993
- Endorsement by New Zealand of the Code of Practice for Forest Harvesting in Asia-Pacific
- Health and Safety in Employment Act, 1992
- Hazardous Substances and New Organisms Act
- The Biosecurity Act.

As well as government-implemented actions, a number of innovative approaches to promote SFM have been initiated by the forest industry in NZ. These include the following:

- The NZ Forest Accord, 1991
(An agreement between the forest industry and environmental and recreational organisations which sets out agreed definitions of areas where it is appropriate to establish plantation forestry, and acknowledges that the existing area of natural indigenous forest in NZ should be maintained and enhanced)
- Principles for Commercial Plantation Forest Management in New Zealand 1996
(A further agreement between the forest industry and conservation groups which expands on ecological, social and economic principles for plantation forest management in recognition of the process of inter-governmental process building on SFM)
- NZ Forest Code of Practice-supported and promoted by the NZ Forest Owners Association. Revised 1993
(The existence of this combination of legislation and voluntary codes and agreements provides a comprehensive level of environmental protection and sustainable management, and involves a high degree of community participation).

Vignette on Russia

Since the tenth meeting of the Montréal Process, held in Moscow in October 1998, the Federal Forest Service of Russia has continued activities previously undertaken within the framework of the Montréal Process.

The All-Russian Research and Information Center for Forest Resources (ARICFR) has developed a draft document (*Instruction for implementing criteria and indicators for sustainable forest management in the Russian Federation*) intended to be an addendum to the *Instructions for carrying out the State Account of the Forest Fund of Russia*. One of the purposes of these documents is to create possibilities for completing the transition to sustainable development in forest management practice in the Russian Federation.

The ARICFR has also developed *Criteria and indicators for sustainable forest management of the Russian Federation*. The document was approved by the order of the Federal Forest Service of Russia on 5 February, 1998. The Russian list includes six criteria with a respective set of indicators. They take into consideration appropriate international lists of criteria and indicators and their suitability for Russian conditions. In their development it was necessary to take into account not only the natural and socio-economic peculiarities of Russia, but also peculiarities of forest governing. As information on forest policy implementation is accumulated, the criteria and indicators may become more correct and precise.

Forest governance in Russia is undertaken by the State (National) system that has been formed over centuries and which was able to preserve the forest wealth of the country. The Federal Forest Service has a branched structure to control the state of forests under its jurisdiction throughout the country. The existing system of accounting, controlling and forecasting trends in forest resources and in forest management is being continuously improved. The implementation of the criteria and indicators for sustainable management is supported by this system, reinforced with nation-wide and regional statistics of social and economic issues of forest management. They permit the detection of trends in order to correct the strategy and, accordingly, are important political reference points.

Despite economic difficulties, scientific research continues with a large proportion aimed at the maintenance and preservation of the productive capacity of forests. Studies deal both with general problems concerning forest productivity throughout the country and with productivity in various regions.

Forest fires are the most important factor that decreases the potential of the forest resources in Russia. About two-thirds of the Forest Fund area is classified as having medium, high and extremely high fire danger. Most widespread are creeping ground fires, which are responsible for 90 per cent of the area burned.

The total area of forest annually burned is about one million hectares. Depending on climatic conditions in a given year, the area burned varies considerably, both nationally and in particular given regions. In spite of active research on the development and introduction of fire-fighting measures, and the availability of a specialised fire-fighting service, results are insignificant because of a lack of means for preventive measures, protection and proper fire-fighting.

The factor of radiation in Russian forests causes noticeable social and ecological effects, although the contaminated area does not exceed 0.5 per cent of stocked forest lands. With a new forest policy, the data on forest radioactive contamination have become available to researchers and to the public at large and, since 1995, their precision has increased. Following the Chernobyl Nuclear Power Plant accident, 958 700 hectares of Forest Fund area were polluted. Currently the Forest Service of Russia is performing special research on the management of forests polluted by radionuclides. A series of normative documents aimed at decreasing the risk of radiation exposure when people stay in polluted forests and at implementing special measures when they carry out forestry or forest cutting operations have been developed and approved.

Russia is developing a network to monitor environmental pollution. Within the framework of the Unified State System of Monitoring, permanent and regular tracking of pollution and the health of forests, near large industrial enterprises, are performed. Research and practical activities are carried out to assess and forecast the health of forests polluted by industrial emissions.

Over 20 per cent of the total Forest Fund lands of Russia are forests of the First Group whose principal purpose is to perform environmental protection functions. The area of these forests is steadily increasing, including anti-erosion forests on lands with broken, hilly topography and mountainous relief, and on gully slopes; forest shelterbelts, and pine forest belts; forests on deflation sands; water protection and regulation stands; forests protecting river banks, lakes and other water bodies against erosion and destruction; and forest belts along rivers with spawning grounds.

Forest biodiversity has been studied in Russia for a long time and at all levels — ecosystem, species and genetic. Documents on forest inventory and planning and on forest evaluation include reliable and abundant material describing biodiversity. The diversity of forests and of forest landscapes is described in terms of forest type, habitat type, tree species, stand health, and classes (groups) of diameter, age and forest site.

A huge amount of material on species diversity of forest phytocoenoses has been accumulated, although a uniform system of data gathering, processing and analysis is still necessary. Rare and vanishing species of plants are studied in depth, and measures are taken to protect them in their natural environment. Red data books have been published for the following members of the Russian Federation: Altai Territory (1994), Arkhangelsk Region (1995), Republic of Bashkortostan (1984, 1987), Vladimir Region (1992), Jewish Autonomous Region (1997), Republic of Karachayevo-Cherkessia (1988), Republic of Karelia (1985, 1995), Krasnodar (1994) and Krasnoyarsk Territories (1995), Moscow Region (1998), Republic of Mariy-El (1997), Orenburg Region (1998), Saratov Region (1996), Smolensk Region (1994), Middle Ural (1996), Republic of Tatarstan (1995), Republic of Sakha (Yakutia) (1987), and Yamalo-Nenets Autonomous District (1997). A new edition of the Red Data Book of the Russian Federation (first published in 1988) is being prepared.

Biodiversity at all levels is studied and maintained in 99 State Nature Zapovedniks (protected nature reserves with permanent scientific research staff) having a total area of over 33 000 000 hectares and at 34 National Parks with a total area of over 6 800 000 hectares. Of these National Parks, 33 are administered by the Federal Forest Service. Twenty-one of the Zapovedniks, totalling over 10 600 000 hectares and varying from 5 918 to 4 169 222 hectares, were established after 1993. Zapovedniks constitute about 2 per cent of the territory of the Russian Federation and National Parks almost 0.4 per cent.

It should be noted that the State Committee of the Russian Federation for Environment Protection published *The First National Report of Russian Federation: Biodiversity Conservation in Russia*, in 1997. The document describes measures taken by various ministries and governmental agencies (including the Federal Forest Service) to fulfil national obligations under the Convention on Biological Diversity.

The inventory of animal and plant life has gone on for a long time and in some cases is nearly finished. There are many guides and descriptions of flora and fauna permitting the exact identification of plant and animal species and, as appropriate, the description of new species and their place in the classification.

Such general guides are missing for forest ecosystems. There are a great number of ecosystems; their delimitation is frequently vague and their stability is dynamic. It is necessary to create official registers of biotic formations and of regions for forest biogeocoenoses. This is especially topical because the biodiversity of forest ecosystems is one of the major criteria of SFM.

The system of accounting for genetic diversity and potential species selection (breeding) is not advanced in practice. However, in recent years there have been intensive studies of genetic side-effects of economic activity on forest ecosystems and the development of genetic and breeding methods for increasing genetic diversity of plants of ancient provenance. The preservation of biological diversity in the Russian Forest Fund is connected to the gradual transition to an ecosystem-minded forest management and the development of appropriate legal requirements to be met in forestry practice and forest use.

During recent years, various researchers have assessed the accumulation and increment of forest biomass as a basis for calculating carbon balance. However, because of the lack of a uniform methodological approach, estimates vary greatly. Scientists at the All-Russian Research and Information Center for Forest Resources (ARICFR) have analysed the methods and have also attempted to determine the causes for uncertainties and errors in the calculations. The work was done with the purpose of developing a uniform methodology for carbon balance calculations in different regions of the country, which is necessary for adopting a strategy of SFM and preservation of biological diversity in view of probable climatic change.

The involvement of citizen groups in the procedure of decision making in forestry and their active co-operation has become a problem for the Russian Federal body of forest management.

Development of forest management programmes, including their financial support, needs to be promoted at the level of State policy and undertaken on an inter-sectoral co-ordinated basis.

In order to enforce the basic clauses of the Forest Code, the Federal Forest Service has prepared a number of legal acts aimed at the organisation of forest management, forest use, control and protection, reproduction of forests, Forest Fund use on especially protected areas, and economic regulation in forest management. These are listed below:

- Rules of implementation of the State control of the condition, use and protection of the Forest Fund and forest reproduction by the Federal Forest Service of Russia and its territorial bodies. Approved by the Ordinance of the Government of the Russian Federation, 1 June, 1998, Number 544
- Guidelines for activities of forest management body of Russian Federation's members. Approved by the Order of the Federal Forest Service of Russia, 15 April, 1998, Number 58.
- Procedure of classifying Forest Groups and protection categories of the First Group forests. Approved by the Ordinance of the Government of the Russian Federation, 15 September, 1997, Number 1169
- Rules of granting on lease of Forest Fund parcels. Approved by the Ordinance of the Government of the Russian Federation, 24 March, 1998, Number 345
- Rules of stumpage in forests of the Russian Federation. Approved by the Ordinance of the Government of the Russian Federation, 1 June 1998, Number 551
- Statute of the State Forest Guard of the Russian Federation. Approved by the Ordinance of the Government of the Russian Federation, 27 July, Number 850
- Sanitary rules in forests of the Russian Federation. Issued by the Order of the Federal Forest Service of Russia, 1 January 1998, Number 10.

The drawing up of *Rules of compulsory certification of stumpage wood and of secondary forest resources* has been completed.

Vignette on the United States

Background

The mix of forest landownerships and the decentralized federal system of government in the USA, present unique challenges to implementation of the Montréal Process criteria and indicators (C&I). Approximately 60 per cent of US forests (180 000 000 hectares) are privately owned. Private owners are not obliged to provide data about their land or to give third parties access to their land for data collection purposes. Furthermore, the 50 states are individually responsible for providing land management guidance for state-owned forests (5 per cent of forest land or 15 000 000 hectares) and private forests. There are 10 000 000 private forest owners in the US whose land comes under state jurisdiction. The remaining 35 per cent of publicly owned forests (105 000 000 hectares) are managed by several agencies of the federal government, including the US Forest Service, Bureau of Land Management, US Park Service, US Fish and Wildlife Service, and the US Department of Defense. Each state, agency, or owner can and does collect different data using different systems, creating a comparability problem. Therefore, for implementation of the Montréal Process C&I to succeed in the US, there must be a collaborative effort among all public and private stakeholders.

Domestic Implementation

Against this backdrop, in July 1998, the US Forest Service Chief initiated the Roundtable on Sustainable Forests, bringing together more than 50 representatives of US federal, state and local government agencies, environmental non-governmental organisations, private landowners, industry and academia, to discuss how best to achieve sustainable management of US forests, both public and private. The Roundtable agreed that the Montréal Process C&I could provide a framework for making assessments of sustainability at the national and sub-national levels. The Roundtable has met regularly since July 1998, drawing up a charter and plan of action to pursue its agenda, including the formation of two working groups, on communications and public outreach and on technical issues. The Communications Working Group has created a Roundtable web site that will soon be available publicly and has taken the Roundtable message to key meetings on domestic forestry and sustainability. The Technical Working Group is organising workshops for early 2000 that will address each criterion and its indicators, assessing what national data sets are available to provide data for the indicators, and what still needs to be accomplished. The results of these workshops will then be presented to the Roundtable at its next meeting. Representatives of the diverse interests on the Roundtable also participated in a panel on US implementation of the Montréal Process C&I at the eleventh Meeting of the Montréal Process Working Group.

Domestic Monitoring and Assessment

In June 1998, the USA made a commitment to prepare a comprehensive national assessment of the status and trends of US forest conditions and management, based on the Montréal Process C&I. The report will be released in 2003 as part of the semi-decadal national assessment of all forest lands and trends in the forest sector required by the Resources Planning Act of 1974. This periodic Presidential report to Congress will be organised using the Montréal Process criteria. The USA has merged, and is expanding, its two existing national forest monitoring systems: the Forest Health Monitoring (FHM) programme, which includes a systematic assessment of numerous indicators of environmental health, and the Forest Inventory and Analysis (FIA) programme, which provides data on forest extent, type, growth and other timber values. The integration and expansion of these systems will improve C&I data collection. The US Forest Service is also staffing the National Inventory and Monitoring Institute, chartered in 1996 to co-ordinate national and sub-national application of inventory systems, including the Montréal Process criteria and indicators.

The US Forest Service in July 1998 officially institutionalised the Montréal Process C&I as the framework for all future forest inventories, assessments, monitoring and performance accountability from the field level to the national level for publicly owned national forests managed by the Forest Service. Several of the 50 states are taking similar steps for state and private forest lands; examples are the 20 north-eastern and south-eastern states' initiatives to assess sustainable forest management (SFM) in these regions. In addition, the Forest Service is pilot testing sub-national C&I and their linkages to national C&I on five national forests. The National Association of State Foresters, which represents the state-level forestry agencies in all 50 states plus the US Territories, is re-evaluating the data gathered by each state or territorial agency to determine how that data can be augmented and better organised so that States can contribute better to national assessments of forest condition and the state of forest management. The experience gained from these sub-national assessments will be useful for the work of national application of the C&I.

The American Forest and Paper Association (AF&PA), a trade group representing US domestic and multinational forest and paper companies (for example, International Paper, Weyerhaeuser, Georgia-Pacific, Boise Cascade), and the Forest Stewardship Council are active in the Roundtable on Sustainable Forests. The AF&PA has created a programme called the Sustainable Forest Initiative (SFI), a voluntary verification process that requires companies to reforest harvested land promptly, provide for wildlife habitat, improve water quality and ecosystem diversity and protect forest land of special ecological significance. Some of the SFI programme data, gathered through the AF&PA reporting mechanisms, can be used for C&I data collection. The Forest Stewardship Council is also building a voluntary certification process that should be a valuable source of data.

Parallel Domestic Processes

In the USA, the management of forests, range lands, and minerals and energy are interrelated. In some cases, it is difficult to discuss the condition of forests without discussing the condition of the surrounding range land (grass and shrub lands) and mineral extraction. Adjacent range and forest lands are always interrelated.

Many forest lands in the USA occur over valuable subsurface mineral deposits and energy sources. In the case of publicly owned national forests, the Forest Service or other land management agencies often have responsibility for managing the subsurface resources as well as the surface forests. Because of this responsibility and its Congressional mandate to report periodically on the conditions of the nation's forest and range resources, the Forest Service has assumed the responsibility of providing national reports on minerals and energy. There is also an appreciation that minerals and energy policy has an influence on forest sustainability. This appreciation, as well as Forest Service use of C&I for forest and range lands, has generated interest in the need for a minerals and energy assessment capability, which in turn would be used to assess their role in sustainable development.

With regard to both range lands and minerals and energy, the lessons learned from the Montréal Process are being used by these sectors. The range management sector is finding many C&I to be of direct use in its work. Data generated from all three sectors will be used in national environmental reports being compiled by the White House.

International Involvement

The USA hosted the Eleventh Meeting of the Montréal Process Working Group, 29 November to 3 December 1999, in Charleston, SC. Major issues on the meeting's agenda included the applicability of national-level C&I at the sub-national level as well as the international context of various C&I initiatives around the world. The USA also serves as convenor of the Montréal Process Technical Advisory Committee, which was created to provide advice to the Working Group on technical and scientific issues that arise in connection with implementation of the Montréal Process C&I.

In July 1998 the USA completed its submission to the Enquiry for the UN-ECE/FAO Temperate and Boreal Forest Resource Assessment (TBFRA) 2000. Data were provided on general forest resources, biological diversity, protection status, wood and carbon supply, forest condition and the socio-economic function of the forests. The US Forest Service has begun looking at developing strategies to increase comparability among the Montréal, Pan-European and TBFRA process C&I. The USA, Canada and Mexico have had preliminary discussions on developing a North American summary database to cross-link resource information.

In the past decade, US forest management institutions have increasingly assumed an international component in their roles. Under the leadership of the Department of State, the forest community involvement in numerous forums has been extensive and substantive. This participation has included the state forestry community, representatives of the non-industrial forest land owners, industry, and environmental groups. The result has been broad institutional support for exploring the application of the concept of forest sustainability. Support for the Montréal Process is part of this growth.

81

Looking Ahead

Through the Roundtable on Sustainable Forests, the USA has engaged domestic stakeholders in implementation of the Montréal Process C&I. The thrust of this collaborative work is to build the institutional capacity to report nationally on the C&I — a formidable task. The Roundtable's technical workshops in the winter of 2000 should generate information on data gaps and assessment problems regarding the Montréal Process C&I.

State-level data are key to this effort. The most valuable contribution that state-level forestry agencies can make to the C&I process is to provide portions of the assessment data. Once the project to re-evaluate state data sources, noted above, is complete, states will need to engage in detailed discussions about standardising and augmenting their data collection activities. Through this process more information can be consolidated at the national-level for use in C&I assessments.

It is also hoped that the various C&I initiatives around the world will work together on key terms and definitions as well as other areas of comparability in the goal of assessing the world's forests.

Vignette on Uruguay

Introduction

In 1995, Uruguay joined the Montréal Process, endorsing the Santiago Declaration and thus adopting the use of criteria and indicators that were approved as the framework for evaluating the sustainable use of forest resources at the national level.

The Forest Division of the Directorate of Renewable Natural Resources of the Ministry of Livestock, Agriculture and Fisheries is the interlocutory institution in the Montréal Process and is responsible for guiding, promoting and co-ordinating the system for implementing the criteria and indicators at the national level.

This report describes the steps that have been taken to implement the criteria and indicators and other actions aimed at the conservation and sustainable management of forest resources. The actions will be grouped on the basis of the criteria defined under the Montréal Process.

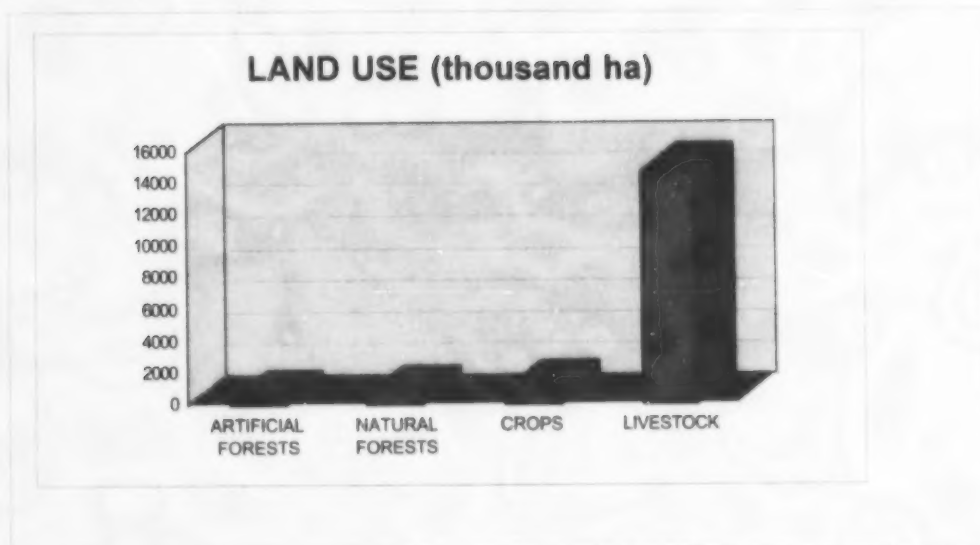
With respect to the status of data and possibilities for reporting the indicators defined in the Montréal Process, after the report produced by the Forest Division in 1996, a workshop was held in 1998 with participants from the main institution forming part of the system for implementing the criteria and indicators. The meeting was attended by representatives of public agencies, research institutes, producer associations, and environmental non-governmental organisations. Updated data are available. The projects being carried out by research institutions are being evaluated this year.

Some basic information on land use, forested areas and changes, and wood extraction are given in figures 8 to 12.

Criterion 1: Conservation of Biological Diversity

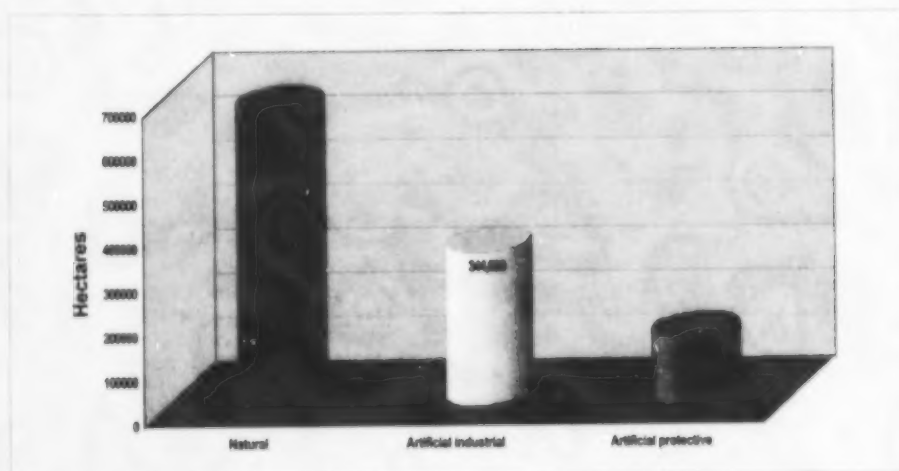
Stage one is the development of a geographic information system. At present it is based on various indicators for forest plantations (1995–1998). In 1999, information from the forest map, based on the interpretation of 1998–1999 satellite images, will be incorporated. Manuals detailing procedures for conducting the forest inventory will be prepared and will include variables for the tree stratum and indicators relating to environmental variables (1999). Additionally, a system for monitoring ecological variables linked to the biodiversity associated with forests will be designed. This project will be carried out by the Agronomy Faculty (1999–2000).

Figure 8. Land Use in Uruguay



83

Figure 9. Forested Area in Uruguay

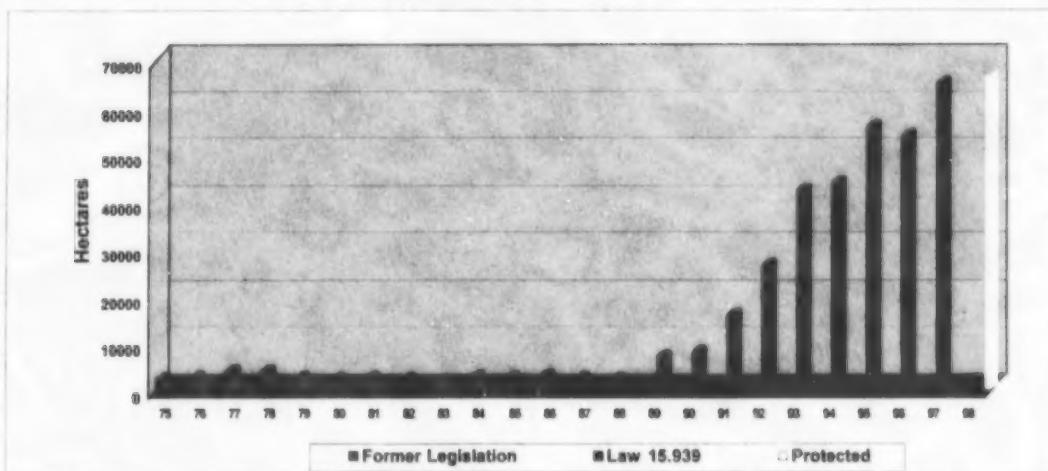


Sources: Natural forests — forest map

Artificial forests for industrial purposes and management plan — forest registry

Artificial protective and service forests and others — forest map and forest registry

Figure 10. Changes in forested area (1975–1998)

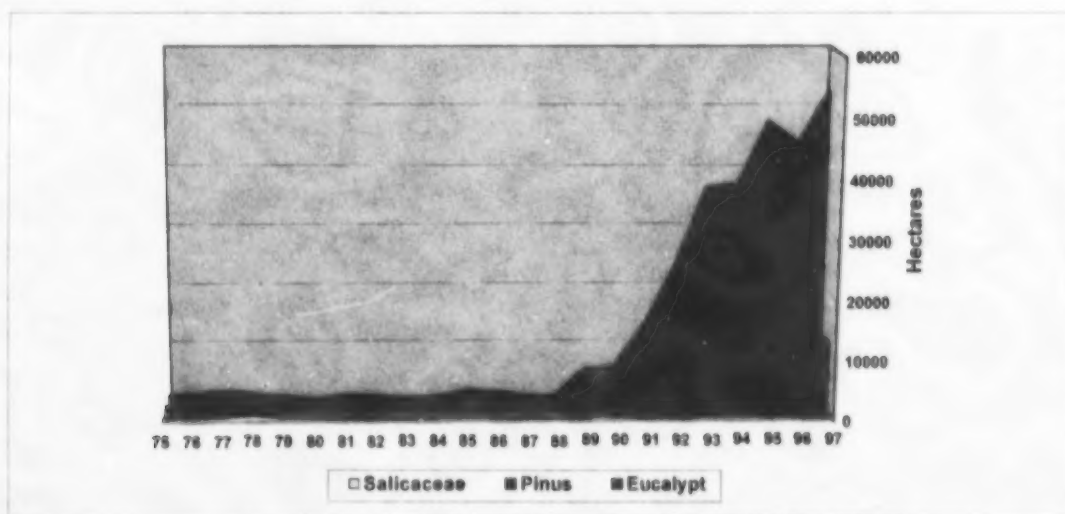


Sources:

The figures for the forested areas include the area actually used for plantations and areas used for firebreaks, access roads and buffer zones.

The plantations have been made under an afforestation and management plan approved by the Forest Division.

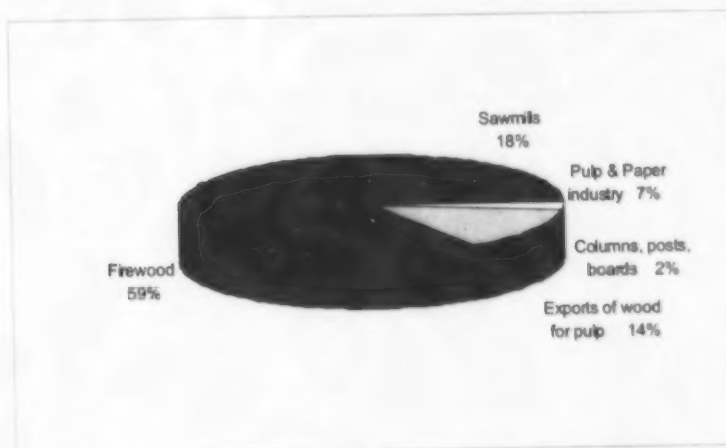
Figure 11. Changes in forested areas (hectares) by species



Criterion 2: Maintenance of the Productive Capacity of Forest Ecosystems

The greatest progress has been made on plantations, based on the information system introduced and better quality data. As for the natural forest, a project profile has been prepared in order to improve the composition and dynamics of information, which will help to achieve sustainable management.

Figure 12. Annual extraction of wood (percentages).



Criterion 3: Maintenance of Forest Ecosystem Health and Vitality

Actions under way:

- Forest monitoring through plant health studies to determine the levels of pests and diseases with emphasis on their linkage to forest management
- Research on biology and integrated control of pests that affect eucalyptus and pine forests
- Survey of exotic plant species that compete with natural forests
- Study of fungal communities that are parasites of eucalyptus.

Short-term activities:

- Evaluation of agro-forestry production systems in relation to the prevalence of toxic fungi
- Evaluation of the behaviour of forests planted on different sites.

Since 1995, over 5 000 hectares of forest plantations have been inspected as a result of plant health complaints laid by producers.

Criterion 4: Conservation and Maintenance of Soil and Water Resources

- Establishment of two pilot watersheds to evaluate the impact of forest activities on soil and water resources
- Introduction of a system for monitoring the chemical and physical properties of land under different types of forest cover (1999–2000)
- Co-ordination with the Soil Division in supervising use and management of land suitable for afforestation under the Land and Water Act and regulations (continuing activity)
- Training abroad for technical experts in restoring the water balance, erosion control, combating deforestation and watershed management (1986, 1991, 1997, 1999).

Criterion 5: Maintenance of Forest Contribution to Global Carbon Cycles

One of the results of the workshop on criteria and indicators was identification of the best institutions to conduct the relevant studies. Projects and activities will be evaluated during 1999.

Criterion 6: Maintenance and Enhancement of Long-term Multiple Socio-economic Benefits to Meet the Needs of Societies

The following studies were carried out in 1994 and 1995:

- Study on the fiscal impact of forest promotion
- Study on the social and economic impact of the Forest Plan (I)
- Study on the social and economic impact of the National Afforestation Plan (II).

These studies were conducted as part of the monitoring activities of the National Afforestation Plan. They have shown highly positive results in comparison with previous production activities carried out on land, where afforestation is being promoted, virtually all of which was used for livestock production.

The study on the fiscal impact of afforestation examined whether forest development in Uruguay is a profitable activity for the government in terms of tax revenues, also considering the different incentives established for producers in the Forestry Act. It sought to establish whether the net fiscal results of this activity are higher than for the main activity that afforestation replaced, that is, livestock farming. Overall returns for the government are much higher from afforestation than from livestock farming. The fiscal returns for the government are in the order of 30 per cent a year, expressed in United States dollars.

From the socio-economic standpoint, the studies reached the following conclusions:

- The coefficient of employment per hectare in forestry is 0.02, whereas the figure for livestock farming is 0.004; in other words, forestry employs five times more labour per hectare than livestock farming
- Wages from forestry are 25 per cent higher than from livestock farming
- Afforestation has enabled women to join the job market in rural areas
- Returns and wages are higher in afforestation than in livestock farming and the generation of higher gross production value per hectare has a greater impact on the national economy.

The Forest Division forms part of the national statistics system co-ordinated by the Statistics Institute. Steps are being taken in this sphere to improve the quality of forest sector data.

- Basic forest industry development plan (1999—Ministry of Industry and Energy (MIE))
- Preparation by the Forest Division of a five-year forest development plan for the period 2000–2004. It lays stress on many of the indicators for Criterion 6.

Criterion 7: Legal, Institutional and Economic Framework for Forest Conservation and Sustainable Management

Basically, the legal framework is composed of:

- The Land and Water Conservation Act (Law 15239 and Decree 289/90)
- The Forestry Act (Law 15939 of December 28, 1987) and its regulations
- Rules for the protection of native wildlife
- The Environmental Act (Law 16466) and Decree 435/994 of December 21, 1994, article 2 (26).

The protection, improvement, expansion and creation of forest resources, development of forest industries, and forest economics in general were declared in the national interest in 1968. National forest policy is formulated and implemented by the Ministry of Livestock, Agriculture and Fisheries. The Renewable Resources Directorate, through the Forest Division, is the executing agency of forest policy.

The policy and legislative framework for forests has the following objectives:

- Protection of natural forests, prohibiting their use, except where management plans, to promote active management, have been approved by the Forest Division
- Expansion of the forest base through forest plantations using appropriate species on land with medium to low agricultural productivity, with a management plan approved by the Forest Division
- Expansion of plantations whose main objective is the protection of other renewable natural resources, particularly land and water, with a management plan approved by the Forest Division.

The following steps are being taken to improve the framework for sector development:

- Preparation of a new instrument for forest project design and implementation on the farm level, ranging from a management plan to a plan for forest management and development (1999)
- Preparation of a forest practices code in co-operation with all the players in the forest sector (compilation of background and preparation of the basic document, 1999).

From the institutional standpoint, actions have been co-ordinated on the regulation level. Under the auspices of the IUCN, the US Forest Service and the Canadian Forest Service, the South American countries that were then members of the Montréal Process (Argentina, Chile and Uruguay) met in Bariloche, Argentina, in April 1997 to study how to strengthen South American participation in the process.

Also at the regional level, a project profile has been prepared for the conservation and management of native forests in the countries of the Southern Cone (Argentina, Brazil, Chile and Uruguay).

Funds for the project are currently being negotiated with the European Union.

On the national level, the forestry component of OBRD Project UR-3697 is currently being executed, including training, technical assistance and applied research, all targeted to sustainable forest management (SFM). Most of the actions described under each of the criteria have been or will be carried out under the frame of this project.

Dissemination and Extension

Since Uruguay endorsed the Santiago Declaration, the Forest Division has been concerned with publicising the actions taken under the framework.

To that end, a series of activities has been carried out that can be summarised as:

- Talks and conferences offered by the Forest Division, Directorate of Renewable Natural Resources, the Association of Agricultural Engineers of Uruguay, meetings with the Association of Forest Producers
- Preparation of articles for specialised publications
- Organisation of a workshop on the status of data and possibilities for reporting the indicators defined at the Montréal Process in order to track the scope of the process.

The subject of SFM — criteria and indicators of the Montréal Process — has been included in the sphere of both public and private universities.

Discussion

The country vignettes that have been prepared demonstrate that the Montréal Process countries are committed to implementation of the Montréal Process Criteria and Indicators (C&I). Indeed, several reports provide information on each of the criteria. However, as has been noted in previous reports, each country is unique with respect to its forests and to their ownership. Additionally, the relative economic and social values of the forests vary dramatically between countries. Accordingly, and as noted in the country vignettes, implementation will vary between countries. While some countries are using the C&I specifically as identified through the Montréal Process, Russia has noted that its list of C&I takes into consideration other appropriate international lists as well as their suitability to Russian conditions. China has identified eight criteria and 80 indicators, which were formulated on the basis of specific Chinese conditions, but are expected to be in line with the Montréal Process C&I. Mexico has indicated that it is establishing a Technical Advisory Committee to adapt the Montréal Process C&I to national considerations. New Zealand has reported that a national environmental indicators program is being developed, but notes that the Montréal Process C&I will be integrated into the overall program. Australia, Canada, China and the USA have discussed the need for sub-national indicators to be applied at the State, Province and Territory level. These sub-national indicators tend to be based on the national indicators, and there is generally a capability to roll up information to the national level. In addition to developing C&I for major geographical and political units, China and Chile are also exploring their use for forest management units. While Argentina, Korea and Uruguay have based their reports on the seven Montréal Process criteria, other countries have been more general in their reporting. All countries have discussed related initiatives that are under way and all have reported on the need to intensify data collection and reporting. Several countries, including Australia, China, Japan, Korea and Russia, have noted the need for research into the development and use of indicators. The close relationships between the Montréal Process and other international C&I initiatives, including the Pan-European Process, have been noted by the United States, while Chile, Korea, New Zealand and the United States have noted linkages between the Montréal Process C&I and the Framework Convention on Climate Change (FCCC). Uruguay has noted the advantages of regional linkages with Argentina, Chile and Uruguay.

There can be little doubt that the countries involved in the Montréal Process have benefited by working together to develop and implement C&I for temperate and boreal forests. The initial benefit was in the identification of the seven criteria and the 67 indicators. This involved the convening of five meetings at which the founding 10 countries, each one unique and different, were able to agree conceptually on the application of an ecosystem approach to forest management and to develop a comprehensive set of C&I to reflect this principle. The member countries have also gained by working together and by sharing experiences, while application of a common set of C&I will help provide a common format for reporting country progress, improve the quality of information available to decision-makers and the general public, and provide better information for the forest policy debate and formulation of policies at national and international levels. Specifically, Australia and China have held two workshops for the purpose of accelerating progress on implementation.

Meetings of the Montréal Process Working Group provide regular opportunities for scientists, forest managers, and policy makers from the member countries to meet and to discuss progress, problems and opportunities. The Montréal Process Working Group has also established a Technical Advisory Committee (TAC), which has reviewed all the indicators and has produced a report that discusses each of them, defines key terms and suggests approaches for their measurement. All countries have benefited from the deliberations of the TAC.

The Montréal Process provides member countries with an opportunity to maintain continuing contact with other international initiatives and groups related to defining and implementing C&I, including the Pan-European Process, the Central American Process, the Near East Process, the Amazon Tarapoto Process and the Dry-Zone Africa Process. These contacts provide an opportunity for stronger technical co-operation and a cross-fertilisation of ideas across various C&I processes. Through the Montréal Process, contact is maintained with the Food and Agricultural Organization of the United Nations (FAO), the Center for International Forestry Research (CIFOR), the International Tropical Timber Organization (ITTO) and the International Union of Forestry Research Organizations (IUFRO). Contact is maintained both by having member countries participate in meetings of these other groups and also by having representatives from other groups attend meetings of the Montréal Process Working Group. And finally, a few representatives of the member countries have been seconded to the Liaison Office in Ottawa and have thus gained an increased understanding of the Process.

Implementation of the Montréal Process C&I is now a priority for member countries. Continuous monitoring will provide the information necessary to assess national forest condition trends and to make the policy decisions needed to move countries toward the sustainable management of their forests. The Montréal Process C&I have the potential to be a leading innovation in forest management.

Appendix A

Montréal Process Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests

91

Criterion 1: Conservation of biological diversity

Biological diversity includes the elements of the diversity of ecosystems, the diversity between species, and genetic diversity in species

Indicators

1.1 Ecosystem diversity

- 1.1.a Extent of area by forest type relative to total forest area
- 1.1.b Extent of area by forest type and by age class or successional stage
- 1.1.c Extent of area by forest type in protected area categories as defined by IUCN or other classification systems
- 1.1.d Extent of areas by forest type in protected areas defined by age class or successional stage
- 1.1.e Fragmentation of forest types

1.2 Species diversity

- 1.2.a The number of forest dependent species
- 1.2.b The status (threatened, rare, vulnerable, endangered, or extinct) of forest dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment

1.3 Genetic diversity

- 1.3.a Number of forest-dependent species that occupy a small portion of their former range
- 1.3.b Population levels of representative species from diverse habitats monitored across their range

Criterion 2: Maintenance of productive capacity of forest ecosystems

Indicators

- 2.a Area of forest land and net area of forest land available for timber production
- 2.b Total growing stock of both merchantable and non-merchantable tree species on forest land available for timber production
- 2.c The area and growing stock of plantations of native and exotic species
- 2.d Annual removal of wood products compared with the volume determined to be sustainable
- 2.e Annual removal of non-timber forest products (e.g. fur bearers, berries, mushrooms, game), compared with the level determined to be sustainable

Criterion 3: Maintenance of forest ecosystem health and vitality

Indicators

- 3.a Area and per cent of forest affected by processes or agents beyond the range of historic variation, e.g. by insects, disease, competition from exotic species, fire, storm, land clearance, permanent flooding, salinisation, and domestic animals
- 3.b Area and per cent of forest land subjected to levels of specific air pollutants (e.g. sulfates, nitrate, ozone) or ultraviolet B that may cause negative impacts on the forest ecosystem
- 3.c Area and per cent of forest land with diminished biological components indicative of changes in fundamental ecological processes (e.g. soil nutrient cycling, seed dispersion, pollination) and/or ecological continuity (monitoring of functionally important species such as fungi, arboreal epiphytes, nematodes, beetles, wasps, etc.)

Criterion 4: Conservation and maintenance of soil and water resources

This criterion encompasses the conservation of soil and water resources and the protective and productive functions of forests.

Indicators

- 4.a Area and per cent of forest land with significant soil erosion
- 4.b Area and per cent of forest land managed primarily for protective functions, e.g. watersheds, flood protection, avalanche protection, riparian zones
- 4.c Per cent of stream kilometres in forested catchments in which stream flow and timing has significantly deviated from the historic range of variation
- 4.d Area and per cent of forest land with significantly diminished soil organic matter and/or changes in other soil chemical properties
- 4.e Area and per cent of forest land with significant compaction or change in soil physical properties resulting from human activities
- 4.f Per cent of water bodies in forest areas (e.g. stream kilometres, lake hectares) with significant variance of biological diversity from the historic range of variability
- 4.g Per cent of water bodies in forest areas (e.g. stream kilometres, lake hectares) with significant variation from the historic range of variability in pH, dissolved oxygen, levels of chemicals (electrical conductivity), sedimentation or temperature change
- 4.h Area and per cent of forest land experiencing an accumulation of persistent toxic substances

Criterion 5: Maintenance of forest contribution to global carbon cycles

Indicators

- 5.a Total forest ecosystem biomass and carbon pool, and if appropriate, by forest type, age class, and successional stages
- 5.b Contribution of forest ecosystems to the total global carbon budget, including absorption and release of carbon (standing biomass, coarse woody debris, peat and soil carbon)
- 5.c Contribution of forest products to the global carbon budget

Criterion 6: Maintenance and Enhancement of Long-term Multiple Socio-economic Benefits to Meet the Needs of Societies

Indicators

6.1 Production and consumption

- 6.1.a Value and volume of wood and wood products production, including value added through downstream processing
- 6.1.b Value and quantities of production of non-wood forest products
- 6.1.c Supply and consumption of wood and wood products, including consumption per capita
- 6.1.d Value of wood and non-wood products production as percentage of GDP
- 6.1.e Degree of recycling of forest products
- 6.1.f Supply and consumption/use of non-wood products

6.2 Recreation and tourism

- 6.2.a Area and per cent of forest land managed for general recreation and tourism, in relation to the total area of forest land
- 6.2.b Number and type of facilities available for general recreation and tourism, in relation to population and forest area
- 6.2.c Number of visitor days attributed to recreation and tourism, in relation to population and forest area

6.3 Investment in the forest sector

- 6.3.a Value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation, and tourism
- 6.3.b Level of expenditure on research and development and education
- 6.3.c Extension and use of new and improved technologies
- 6.3.d Rates of return on investment

6.4 *Cultural, social and spiritual needs and values*

6.4.a Area and per cent of forest land managed in relation to the total area of forest land to protect the range of cultural, social and spiritual needs and values

6.4.b Non-consumptive use forest values

6.5 *Employment and community needs*

6.5.a Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment

6.5.b Average wage rates and injury rates in major employment categories within the forest sector

6.5.c Viability and adaptability to changing economic conditions, of forest dependent communities, including indigenous communities

6.5.d Area and per cent of forest land use for subsistence purposes

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management

Indicators

7.1 *Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it:*

7.1.a Clarifies property rights, provides for appropriate land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides means of resolving property disputes by due process

7.1.b Provides for periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including co-ordination with relevant sectors

7.1.c Provides opportunities for public participation in public policy and decision-making related to forests and public access to information

7.1.d Encourages best practice codes for forest management

7.1.e Provides for the management of forests to conserve special environmental, cultural, social and/or scientific values

7.2 *Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to:*

- 7.2.a Provide for public involvement activities and public education, awareness and extension programs, and make available forest-related information
- 7.2.b Undertake and implement periodic forest-related planning, assessment, and policy review including cross-sectoral planning and co-ordination
- 7.2.c Develop and maintain human resource skills across relevant disciplines
- 7.2.d Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management
- 7.2.e Enforce laws, regulations and guidelines

7.3 *Extent to which the economic framework (economic policies and measures) supports the conservation and sustainable management of forests through:*

- 7.3.a Investment and taxation policies and a regulatory environment which recognize the long-term nature of investments and permit the flow of capital in and out of the forest sector in response to market signals, non-market economic valuations, and public policy decisions in order to meet long-term demands for forest products and services
- 7.3.b Non-discriminatory trade policies for forest products

7.4 *Capacity to measure and monitor changes in the conservation and sustainable management of forests, including:*

- 7.4.a Availability and extent of up-to-date data, statistics and other information important to measuring or describing indicators associated with criteria 1–7
- 7.4.b Scope, frequency and statistical reliability of forest inventories, assessments, monitoring and other relevant information
- 7.4.c Compatibility with other countries in measuring, monitoring and reporting on indicators

7.5 *Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services, including:*

- 7.5.a Development of scientific understanding of forest ecosystem characteristics and functions
- 7.5.b Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems
- 7.5.c New technologies and the capacity to assess the socio-economic consequences associated with the introduction of new technologies
- 7.5.d Enhancement of ability to predict impacts of human intervention on forests
- 7.5.e Ability to predict impacts on forests of possible climate change